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ABSTRACT

Proceedings of the 1985 Invitational Research Symposium on Special Education Technology are summarized. The document contains a summary of each of 28 individual presentations, plus 10 research summaries submitted by individual participants, and 42 summaries on current technology-based research in special education. The first section reviews presentations in seven sessions: (1) rationale for technology research, (2) research on the effectiveness of microcomputers in special education, (3) research and development of special education authoring systems, (4) major technology-based research initiatives, (5) the use of advanced technologies in special education, (6) reports of research in progress, and (7) funding for technology-based research. Research summaries review procedures and findings and list the funding source and the researcher's name and address. (CL)

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INVITATIONAL Research Symposium ON SPECIAL EDUCATION TECHNOLOGY

June 2-4, 1985

SYMPOSIUM PROCEEDINGS

EC180948

Conducted by
The Center for Special Education Technology

Funded by
Office of Special Education Programs
U.S. Department of Education

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PREFACE

The 1985 Invitational Research Symposium on Special Education Technology was conducted by the Center for Special Education Technology. The Center, funded by the Office of Special Education Programs of the U.S. Department of Education, is a national resource for information concerning the use of technology in the education of handicapped children and youth.

The purpose of the symposium was to provide a forum for researchers actively involved in the systematic investigation of technology in special education to:

- examine the status of technology-based research and the issues encountered by investigators;
- exchange information about current special education technology research projects; and
- develop formal and informal mechanisms for networking among active researchers.

The symposium program included seven major sessions and twenty-eight individual presentations. In addition to the presentations, participants attending the meeting provided a brief summary of current research investigations. This proceedings document contains a summary of each presentation and the research summaries submitted by individual participants. There are three sections in the document.

Section 1: Presentation Summaries
Section 2: Research Summaries: Presenters
Section 3: Research Summaries: Participants

The twenty-eight presentation summaries in Section 1 were prepared by Center staff based on taped recordings of each session. The ten research summaries in Section 2 were written by the individual investigators and complement the material in Section 1. The forty-two summaries in the last section were submitted by participants and represent an information base on current technology-based research in special education.

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SUMMARY OF PRESENTATIONS

SUMMARIES ARE ORDERED AS PRESENTED

Martin Kaufman
Ted Hasselbring
John Alden
James A. Kulik
Kathleen M. Hurley
Robert Yin
Herbert Rieth
Melvyn I. Semmel
David Malouf
Joseph Lamos
Marion Panyan/Paul Hazan
Robert Zuckerman
Gregory Jackson
Gwendolyn Moore/Liz Lahm
Susan Jo Russell
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Richard P. Brinker
Richard D. Howell
Ron Thorkildsen
Philip M. Prinz
Roger Awad-Edwards
Al Cavalier
Mary Leonard
Richard Taft
Edward Esty
David Gray
Richard Johnson
Martin Kaufman

SESSION 1: TECHNOLOGY RESEARCH: WHY BOTHER?

Martin J. Kaufman, Director of the Division of Educational Services, SEP/OSERS, welcomed the symposium participants and discussed SEP's commitment to educational research.

The purpose of the opening panel presentation was to offer a range of perspectives on the status of technology-based research. Speakers, representing commercial and academic perspectives, identified issues faced by researchers, research questions that need to be investigated, and alternate research designs for the systematic investigation of educational technology.

Ted Hasselbring, Peabody College, Vanderbilt University
John Alden, Texas Instruments
James Kulik, The University of Michigan
Kathleen Hurley, Grolier Electronic Publishing
Robert Yin, The COSMOS Corporation

Dr. Martin Kaufman, Director, Division of Educational Services, OSEP, welcomed the participants to the symposium.

Dr. Kaufman summarized the mission of the Office of Special Education Programs to provide leadership and fiscal resources for the initiation, expansion and improvement of education services to handicapped children. The programs administered by OSEP are both entitlement programs and discretionary programs. Within those two broad categories there are opportunities to support research, training, demonstration, and technical assistance projects. OSEP also provides policy clarification and compliance monitoring. It is in the synergism of programs that a faster rate of adoption for research programs is realized. The integrated set of comprehensive strategies provides a means for leadership and to flow fiscal resources to the special education community.

The systematic effect of those research programs is that innovative change occurs faster and more evenly on a national basis than it would otherwise. The contributions of the research program in general and, the technology research in particular, are in a number of areas. One contribution is in the area of providing new knowledge and understanding. For example, the technology effectiveness grants provide new knowledge, confirm old knowledge and apply findings to the instructional design of software.

A second contribution of the research program is to develop and verify effective practice. The research program also contributes to innovative change by reviewing and analyzing current research and practices. An example of fostering innovative change is the research of COSMOS Corporation. That project is reviewing and analyzing current applications of and future projections for artificial intelligence, robotics and simulation for handicapped children.

A fourth area where research contributes is in the development of new or improved approaches to product development based on research findings. Two examples in the technology program are the efforts to develop authoring systems and the compensatory applications of technology. In these projects the concern is not only to develop a product but to demonstrate the effective new designs and features of the product.

A fifth area where the research program contributes is in information exchange. This happens in a number of ways. The Center for Special Education Technology makes information available not only to the research community but to direct service providers as well as institutions of higher education. Through access to synthesized and current listings of information, hopefully the change process has more continuity as a result of lower cost access to information that is difficult to obtain and rapidly changing.

Finally, the research program provides the nation a problem solving capacity. Active researchers represent a capacity to take experience, training, and knowledge, and apply it to emerging situations.

Research contributes to the Office's mission of initiating, expanding and improving services to handicapped children in several ways. The impact does not occur from a single study, because a single study rarely is compelling, comprehensive and convincing enough in its findings to bring about change by itself. But it is through the cumulative effect of studies that a concept is legitimized and that innovative change begins. Through research, utility and effectiveness of concepts are demonstrated. Knowledge and practice are incorporated into personnel preparation programs. Findings are adopted as instructional design standards by commercial publishers. In the end, the contributions of research do make a difference and they do bring about change.

The expectations for this symposium are concerned with information exchange and with the problem solving capacity of the participants. This meeting will enhance the continuity of research and development. The program is designed to strenghten the performing community.

The research community, if it is to effect change, must be disciplined enough to think in terms of how their research affects the school's ethos, the school organization, teacher values and expectancies, staffing of schools, and curricula integration. Only when we can state our visions and have our work fit those visions, can we integrate technology into the schools and classrooms for educating handicapped children.

Ted Hasselbring, Associate Professor at Peabody College, Vanderbilt University focused on the use of single subject designs in technology-based research. He suggested a need to move from attempts to validate some generalized effectiveness model of technology in large group studies to investigations that focus on the individual learner. He notes that others have identified other directions for technology-based research and suggested investigating technology as it relates to individualized learning.

Hasselbring used data from a set of studies to illustrate the importance of analyzing individual data to assess the effectiveness of computer-based learning. The set of studies was designed to examine the effects of arcade-style drill and practice games on learning of mathematics disabled children.

One reason for choosing the arcade games format was the high reported use of that software by teachers. Surveys of software use in the public schools suggested that in 80 percent or more of cases, teachers were advocating the use of this type of drill and practice software for mathematics instruction in special education. Another reason was that there was very little evidence of the effectiveness of that type of software even though it was widely advocated.

The studies did not compare computerized drill and practice against more traditional methods but looked within the drill and practice format. Independent variables included: the speed of the game, the level of user control, the amount of play time, and the length of time the game was used. The dependent variable in all cases was the subject's rate of correct responding.

Rate rather than accuracy was used because all subjects scored very high on the pretest. Most were close to 100% accuracy level. However, in terms of rates of addition and subtraction, scores dropped drastically. The three studies had very consistent results. In virtually all cases the drill and practice had some moderate positive effect when group data was analyzed. Regardless of the variables manipulated, there were positive gains in almost all cases. A consistent finding within groups was that some subjects had an increase of over 100% in the rate of correct responding and others made virtually no gains at all. Within groups gains ranged from low to high. Regardless of the treatment, group gains remained positive.

There is significant literature in cognitive psychology on mathematics, primarily with non-handicapped. One frequently cited study by Groen and Parkman, looked at how students process 2 digit addition problems. They proposed three cognitive models that students use when processing addition problems: a counting-all model, a counting-on model and a min-model. The number of increments used to process addition problems varies with each model. For example, if the student is using the counting-all model with the problem 3+5, the counter is set to 0 and they begin to count. There are 8 increments to be counted using this model. The counting-on model differs in that the student sets the counter to the first number encountered. In the case of 3+5, the counter is set to 3 and incremented 5 times. In the min-model the student identifies the larger number, in this case 5, and increments three times.

We applied these findings to our sample to see if students were using the min-model and also whether computerized drill and practice would move them from a counting model, the min-model, to a reproductive process where they reproduced the answer from memory. We took pretest data, latency of responding data on all subjects and then provided drill and practice using arcade-style software. We found that after 20 to 30 days of computerized drill and practice students were still using a min-model. At best we were reducing the amount of time or making them more efficient at using the min-model. That's why when looking at rates we got moderately positive gains. We also found that there is a ceiling. There is a peak rate of responding when using the min-model and over time subjects who reached the ceiling began making errors.

We concluded that drill and practice itself had very little effect on changing cognitive strategies the children used. So if we are trying to get students to memorize facts, the data suggests that computerized drill and practice is not very effective in changing cognitive strategies. We also found that with a relatively short pretest we can determine what model an individual is using. The next step in this research is to intervene in some meaningful way that moves students from primative counting-on strategies to reproductive strategies. Our findings may be incorporated in software that identifies cognitive strategies and provides effective interventions.

John Alden, Manager of Educational Marketing at Texas Instruments reviewed current trends in computer technology, identified problems with current technology-based research in education and suggested some solutions to these problems.

Alden indicated that in fiscal year 1984, Texas Instruments spent 691 million dollars on research or about 10 percent of the company's gross sales of 5.7 billion. The forecast for 1985 is 830 million dollars. The major gains of this research and development are focused on productivity as well as on finding new products and services. The gains in productivity result from innovation.

The changes in computer technology will impact educational research investigations. Texas Instruments uses a term - AEGs - to measure the number of intelligent activities on a given chip. In a few years, there will be chips available that have a million AEGs. As chips become more dense, the probability of error grows exponentially. The complexity of chips is at the point where it is impossible for a human being to control the design process. The point is that our ability to put information in a computer will grow exponentially in the next few years.

Alden cited a recent National Academy of Sciences report on research in precollegiate education that suggests that most educational research is behind the cutting edge of technology. The report noted three levels of computer use in education. Level 1 is characterized as common uses of technology such as drill and practice or programming. A level 2 application is defined as representing a diversity of efforts that are important for discovering the ways to use technology effectively in education. Level 3 is characterized as advanced theory and systems development. An example is artificial intelligence (AI) research. Pragmatically the research is oriented toward constructing expert systems that represent various knowledges both of the domain and of the learner.

Alden drew several conclusions about the status of educational research. First, the current investment in micros has limited effectiveness because the technology does not deal with higher order thinking skills that are the basis for self directed learning. Second, current practice in education has a disassociation between formal schooling and experiential use learning. Third, the presence of micros has set the stage for a persuasive kind of computer literacy. The ubiquity of computers in the schools is raising the cumulative learning capacity of students. This increase in the overall learning capacity of students is something very profound.

Fourth, symbolic computing or AI computing is the key for education research. It has a close tie to cognitive psychology. For example, LISP as a language is powerful and allows for the quick prototyping of problems and programs. Research can already demonstrate intelligent diagnostic coaching and discovery learning systems. Increased scientific research will allow us to tailor instruction for individuals to a degree not generally done outside of the apprenticeship that is prevalent in graduate schools and other research environments. New forms of AI research, especially from cognitive psychology, set the stage for higher potential research benefits.

There are several things that can be done. First, all of us involved in research need to change our attitudes about what research is. Alden suggests a need to change the metaphor on which research is based. An example is the Idea Program at TI. This program provides small grants to spur innovation well ahead of major funding in the laboratory. A good number of TI's best innovations, include Speak and Spell, came out of the Idea Program. The Program grants must lead to revolutionary improvements in products or methods. The innovation should have step-function impact on some portion of TIs business. Alden suggested the notion as a yardstick for R&D in education.

A second thing is to think about productivity. If you think about productivity, you change the metaphor of research to concentrate on pedagogical and curricular changes that result from the widespread use of computational power. Alden indicates that few examples of advanced research can be found in the educational literature -- there are no step-function studies. Alden indicated a need to concentrate on the level 3 kind of research. He said that to do otherwise puts researchers far behind the leading edge of technology.

James A. Kulik of The University of Michigan reviewed the findings of meta-analyses on computer-based education (CBE) conducted by investigators at the Center for Research on Learning and Teaching. Separate meta-analyses have been completed on the effectiveness of computer-based education (CBE) in elementary schools, high schools, colleges and nontraditional post secondary institutions. Kulik defined meta-analysis as the statistical analysis of the results of a large collection of independently conducted studies. The meta-analyst uses subjective techniques to search literature and library databases to find all the studies done on a certain topic. All the features of the studies are coded and expressed in quantifiable or comparable terms. The features coded are then statistically integrated to determine what study features are affecting the results, what the average results are, etc.

The purpose of the meta-analyses was to get an overview of what the effects of CBE have been in the typical study. One hundred ninety-nine formal controlled evaluations of the effects of the computer in education were identified. Features of the studies such as methodology used, the setting of study, the publication source and history, as well as outcomes such as effects on learning and attitudes were coded. The two sources of data were then analyzed to determine findings of the typical study and whether certain types of studies were producing unique results.

Kulik reported that the criterion in virtually all studies was student learning. Overall results indicated that most CBE programs have had positive effects on student learning. Specific findings include: students have generally learned more in classes when they have recieved help from computers; students remembered what they learned longer; students also learned their lessons with less instructional time; students liked their classes more when they received computer help; and students developed more positive attitudes toward computers when they used them in school. However, computers did not have positive effects in every area studied.

CBE was not uniformly successful in all its guises and at all instructional levels. Effects of computer assisted instruction (CAI), computer-managed instruction (CMI), and computer-enriched instruction (CEI) were different at different instructional levels. CAI was defined as drill and practice and tutorial instruction where students received instruction directly from the computer. CMI included recordkeeping, online and off-line testing, and scheduling where students weren't directly instructed by the computer. CEI included uses of the computer as a tool for calculation, simulation, and programming.

Elementary schools have had a good deal of success in increasing student achievement through CAI programs; they have had less demonstrable success with CMI and CEI. Secondary schools have had success with CAI and CMI but less success with CEI. College and adult courses have benefited moderately from CAI, CMI, and CEI. Future programs of implementation and development should also take these findings into account.

Both journal articles and dissertations present a basically positive picture of CBE effectiveness, but the findings reported in journal articles are clearly more favorable. Research is badly needed to determine the factors that produce differences in journal and dissertation results because such differences have been found in a number of different areas in social science research. Does editorial gatekeeping lead professional journals to present a distorted picture of social science findings? Or do dissertation authors simply measure experimental effects less well than do more seasoned researchers?

Although a variety of different research designs can be used to show the effectiveness of CBE, certain research designs seem to produce more positive results. Studies where the same instructor teaches both experimental and control classes, for example, report somewhat weaker effects than do studies with different experimental and control teachers. Studies of long duration often report weaker effects than do short studies. Reasons for the difference in results from studies using different experimental designs are imperfectly understood, however. Research on such factors should be encouraged.

Kathleen Hurley, Vice-President of Microcomputer Software at Grolier Electronic Publishing, focused on how publishers can work with researchers. Hurley indicated that for publishers it's a time when production of educational materials is expensive. Publishers find themselves spending $50,000 to $100,000 for a product that is dated as soon as it is published. From the viewpoint of a commercial publisher, the first consideration is one of dollars and cents. Hurley indicated that many think the educational software market is very good. In 1983, 93 million dollars was spent on educational software for use in the home and in schools. In 1984, 186 million dollars was spent. It is projected that 318 million dollars will be spent in 1985.

In 1983, the schools spent 38 million dollars on software. However software sales represented only 3.6% of the total elementary and high school instructional materials sales. In dollars this amounts to 38 million for software versus a total of almost 2 billion for other kinds of instructional material. The special education market represents only about 10% of the overall population in schools. Assuming that sales of 5000 copies of a product is considered satisfactory by an educational publisher, in the special education market the projected sales figure would be reduced to 500 copies. The average product cost $30,000 to develop. The retail cost of the product is about $60.00. Add to that the manufacturing, advertising and marketing costs and the publisher's cost per unit on sales of 500 units becomes prohibitive.

Hurley suggests that there are several solutions to the problem of developing materials for special education if publishers and researchers work together. One suggestion is that there be subsidies or shared costs from the Department of Education or educational associations that would provide incentives for publishers to develop and market special education software. Breaks for publishers on advertising in special education journals would make their products known in the special education marketplace. Hurley also suggested collaboration between publishers and educators to adapt or modify existing software for use with both handicapped and non-handicapped populations. This would ensure lower cost per unit through higher production.

Another suggestion is that publishers make more use of research findings. For example, publishers could call on researchers to identify and interpret data that relates to product development. Research findings could be incorporated into product planning and specifications. Publishers could field test products using accepted techniques derived from the work of researchers. They could also revise existing software programs using data from current research efforts.

Publishers want to know specific considerations to be aware of, such as the presence or absence of graphics, when developing special education software. They want to know what adaption should be incorporated in a product for different handicapping conditions or what field testing techniques can be used and how much field testing is necessary.

Hurley indicated that software publishers have become increasingly more sophisticated regarding the development of special education software. However, there are several issues that publishers continue to face in order to keep pace with software developments. The first issue is a dollars and cents one. Questions of a viable market, recovery of development costs, effective entry into the special education market and collaboration with researchers and other education professionals persist. Second, is the inability of publishers to keep abreast of the current research and to find ways to collaborate with researchers in the design of special education software. Guidelines need to be developed that will result in simple, consistent printed commands, minimal lines of print, and other relevant design features. A related issue is how to go from theory to practice. Publishers must be able to interpret research on computer technology and use it to develop practical software. There is a lot of descriptive research available, but more basic and applied research that will contribute to product development is needed. Finally, collaboration between publishers and researchers is needed. Ideally, there would be shared costs for initial conceptualization and field testing. Closer collaboration between publishers, the Department of Education, and CEC and other professional organizations is also needed. The last area of collaboration is that of researchers and hardware manufacturers to plan low cost adaptions and modifications to computers for use with handicapped students.

Dr. Robert Yin, President of COSMOS Corporation, indicated that researchers dealing with rapidly advancing technology have to identify the limitations and possible adaptations of the research methods used. The case study is a powerful tool for technology-based research. Yin listed five topics to consider when using this methodology: defining the problem, designing the study, collecting the data, analyzing the data, and reporting the findings. The literature on research methodology addresses data collection problems but provides little information on the definitional or design problems.

The consummate characteristic of a case study is the ability to study the context and not just the phenomena. Sometimes the phenomenon studied does not have sharp boundaries from the context. Inevitably there are more variables than data points. It is a different technical situation. You can't talk about variance and means, you must search for other techniques. In organizational studies, implementation studies, or studies of the development of technology, it is difficult to limit the study to a particular phenomenon resulting in analytic problems.

Yin discussed COSMOS' study of advanced technology to illustrate the considerations in defining a case. The study was to identify existing uses of robotics, artificial intelligence (AI) and simulation outside of education and to determine possible future applications for special education. The problem from the research point of view was to define what was to be studied. In robotics for example, the first inclination was to study a robot in the lab or an industrial setting. What is generally found in these settings is an arm, a gripper, a computer and an environment that provide things to be manipulated. That is the most common application of robots today. If the researcher had defined the case as this apparatus, subsequent studies would probably focus on the technical development of the apparatus. To get a potential use, a more abstract unit of analysis called an application was developed. The apparatus under study had to be in use on a routine basis in a real environment. That whole situation would be the subject of study. If the original case had been defined as the technology, it would have led to one set of inquiries. If the case was defined as an application, there would be an entirely different set of inquiries. It is not a question of one definition being right or wrong, but the importance of the choice a researcher makes at the beginning of the case study.

Yin sited another example of a study of microcomputer implementation in special education programs. The focus was on implementation so effects were not studied. The question asked was -- why in some schools, in some programs,is microcomputer use growing so rapidly? We wanted to examine different factors such as wealth of the district, teacher training, etc. however, only twelve districts could be included in the study. This is a design problem -- how do you choose 12 districts when you want to represent district size, region of the country, racial, ethic, income and curriculum variables? Twelve cases is not enough.

To choose 12 sites as a good paradigm is the same thing as choosing 12 experiments in the lab. What you have to do is develop some theories. You look for situations in which you can replicate, even if you can't manipulate. If you can predict that the same things will happen in two, three or four cases and they do replicate each other, that's a very potent outcome. Twelve becomes a large number. We can choose four cases because they concentrated on administrative use only. Our prediction is that if you concentrate only on adminstrative uses the system will not grow. It will rapidly become a mainframe system. You can choose another four cases because they only use the microcomputers for instructional applications. The prediction is that use will grow but not as rapidly as the third situation, which is when there are computers for both administration and instructional applications. The prediction is that in those districts there is a complementarity of applications that draw the best organizational support. We predicted better, smoother implementation in those districts.

If you can think about 12 being a large number in that situation, a lot of things can be accomplished with that kind of logic and that kind of design. Yin's examples illustrated two of the more difficult steps in conducting case study research. Case study research is an appropriate technique for studying technology. With careful attention to definitional and design problems, case study methodology can be rigorously applied.

SESSION 2: RESEARCH ON THE EFFECTIVENESS OF MICROCOMPUTERS IN SPECIAL EDUCATION

Reports of three major SEP-funded studies on the use and effectiveness of microcomputers with mildly handicapped students. The four year studies are intended to build an initial knowledge base on effective computer use in special education. The principal investigators discussed research design and methodology, issues encountered in conducting the research investigation and the preliminary findings of their investigations.

Herbert Rieth, Indiana University
Melvyn Semmel, The University of California at Santa Barbara
David Malouf, The University of Maryland

Dr. Rieth, of Indiana University, reviewed findings from earlier research at The Center for Innovation in Teaching the Handicapped (CITH), that had bearing on the current investigation of microcomptuer effectiveness. In an earlier study of secondary environments, teachers designed classroom environments using principles of effective teaching. The secondary environments were effective in producing academic gains. Mildly handicapped, inner city students gained two and three years. There was also some data to suggest that microcomputers could have a delirious effect on student performance. That is, the effect of good instruction could be neutralized by ineffective use of micros. The data suggested that students were not necessarily learning even when micros were used extensively and were viewed by teachers as an integral part of the classroom instructional environments. Findings suggested that teachers weren't looking at the assessment information provided by the computer. As a result students using drill and practice software were often working on skills learned two or three years earlier. Another finding was that even though students were not gaining academically, they were still attending to the task at a very high rate. The rates of engagement on the current study are about 90%. This is active engagement where students are emitting responses.

In most of the general teacher effectiveness literature, active engagement is usually correlated with achievement growth. The current research suggests that to some extent the microcomputer magnified many of the instructional problems in classrooms. Teachers are ineffective in monitoring students. There are cases of students making the same errors over a two week period and teachers were not using the data available to detect these errors.

The present research is being conducted in three school systems -- a large urban district, a suburban and a semi-rural school district. In the first year of the study quantitative, and qualitative methodologies were used to study the general context of the secondary school community and the impact of microcomputers in that environment. Impact on student behavior, teacher behavior and curricular content were studied, as were the range of materials used for instruction, the frequency of use of different types of materials, and grouping practices in secondary classrooms. Classroom observations and interviews with administrators, teachers, parents and students were conducted to provide descriptive information on general ecology of the secondary environment and the use of microcomputers.

First year data were collected using an observation system developed in an earlier study of academic learning time. Technology was an integral part of the data collection process. The whole process was paperless using Epson HX20's and a communication package for data transfer. During the first year over 18,000 observations were conducted and no data was lost. A point time sampling system was used. Students were randomly selected for observation. Behavior of target students was coded as actively engaged, passively engaged, engaged with directions, and off task. Teacher behavior was also observed.

Findings indicated that the highest percentage of computer use was in the content area of mathematics. Computers in classrooms were in use about twenty-five percent of the time. The average time for individual students was 12 to 13 minutes. Much of the computer-based instruction occured in conjuction with paper-and-pencil activities. Reith reported that student computer use also freed up teacher time. However, that time was not reinvested in instruction, but rather in supervision-type activities.

Student engagement rates across the three types of engagement was close to 80%. Students were operating in isolation. The amount of academic feedback was only 1 to 2%. This finding led to an intervention study to determine how feedback can be delivered to students engaged in computer learning.

Researchers found that feedback was effective. The longer students were on the computer, and the more feedback they got, the better their academic performance. However, teachers could not provide feedback to students using the computer and maintain feedback to other students as well. Profiles of teacher behavior were roughly comparable when the computers in use and when it's not in use. This suggests that teachers are not doing much different when the computer is in use. The presence of the device does not alter teacher behavior, even though the districts in the study provided training on the effective use of computer for teachers. A training intervention was designed. Researchers found that providing teachers with general strategies for integrating microcomputers into the classrooms was not effective as a training strategy. Training teachers to use a specific piece of software was more effective.

The third and fourth years of the study will extend the preliminary efforts at intervention using applied behavior analysis methodologies. Environments for teacher training and effective use of software will be designed and the impact on learning outcomes measured.

Dr. Semmel, of the University of California at Santa Barbara, discussed the approach used in the four-year microcomputer effectiveness study and the theoretical notions emerging from that approach. One of the problems at the outset of the study was to conceptualize the aspects of microcomputer use to be studied. A theoretical framework to guide the research investigation was developed. The problems in assessing the effectiveness of microcomputers with mildly handicapped elementary school youngsters were viewed in terms of three facets in a quasi-path model. The three facets were defined as allocation access variables, and use and outcome variables. A comprehensive system was necessary because of the likelihood that these are exogenous forces or causal constraints on each subsequent level of the problem. For example, the process by which technology is allocated has an impact on the school site distribution of technology, which in turn has an impact on administrative arrangement and delivery system variables.

Researchers developed the concept of the Micro-Educational Environments (MEEs) and looked for variation in learner characteristics, technical configurations, instructional content and characteristics of personnel involved in each environment. Combinations and variations of those variables resulted in variations between MEEs. It is the MEEs that have a direct effect on computer access leading to pupil use and eventual effects.

The overall strategy for the four year study was to start with outcome prediction studies with fidelity to standard sampling techniques allowing generalization to the populations of interest. Survey, interview and direct observation techniques were used. The idea in the initial data collection phase was to develop a number of sources of data on similar questions. In the second year, that data would be used to develop some hypotheses relative to MEEs that might be effective, identifying the variables and constructing different models in the laboratory. In subsequent years, controlled applied studies and validation studies will be conducted in the field with the eventual goal of developing a delivery system model.

Semmel reported on the first year of data collection from the administrative and teacher surveys and the student/classroom observations. Also reported were the results of an independent ethnographic study in two school districts using case study methodology, in relation to quantitative findings. In this study, a second research team is working blind with no access to the results of other studies. This strategy permits the cross validation of qualitative and quantitative findings.

In looking at allocation variables, one question was to determine the status of hardware in schools. A survey of a random sample of administrators provided information about the distribution of microcomputers. Apple computers were the dominant hardware at the elementary level. In the study at Indiana, Rieth found few Apples at the secondary level. Studies will be conducted to assess the problems students have in moving from one type of computer to another.

Fifty-one percent of microcomputers used in special education are acquired through general funds. In these California districts sampled, only 8% of hardware was acquired through donations including the Apple give-away program. In general the acquisition of equipment was very rapid. One concern with the current acceptance of 32 bit machines, particularly the Macintosh, is that schools will be unable to reinvest in new equipment and will be forced to continue using the IIe. A tendency toward centralization of hardware and software acquisition decisions was identified. Centralization at the district level is rather distal from where the microcomputer instruction is to be delivered.

Teachers in special day classes, resource rooms and regular education (mainstream) settings were surveyed. Eighty-two percent of special class, 60% of resource room teachers and 91% of regular class teachers reported having access to microcomputers. Forty percent of resource room teachers selected randomly did not have access to microcomputers compared to only 8% of regular class teachers. A mobile cart was the predominent mode of locating equipment for all classrooms except the resource room. This finding shows the general demand and shortage of hardware that necessitates transporting equipment. It also demonstrates a differentiation with respect to regular and special class settings.

A relevant finding in the case studies was that schools go through a natural evolution with respect to the allocation of hardware. The process begins informally with someone being interested in the technology. It evolves as the technology gets into the schools. Competition for the equipment starts very rapidly and leads to a distribution by class. That distribution by class causes conflict and eventually tremendous pressures build up to centralize microcomputer equipment into a lab. Schools with established microcomputer delivery systems are moving to centralization very rapidly. They are also centralizing the curriculum around the equipment.

The teacher survey data showed that group instruction is an important delivery device as compared to individualized instruction. This finding has implications for the development of MEEs and educational software. Teachers in all classroom settings indicated that the primary use of microcomputers was to supplement or reinforce existing programs. Use of computers to teach new skills was rated lowest in special education settings. The predominant intention of the teacher is not that the computer teach new skills.

A direct observation study of ninety classes validated findings about the predominancy of Apples and also showed more "off-brand", obsolete equipment being used in special day classes. This finding has implications with regard to the quantity and quality of software products available for this setting. In addition, it could be concluded that microcomputer equipment is being segregated with students in segregated settings. Special education personnel are not taking advantage of the opportunity to integrate students with lab settings.

Levels of engagement were high in all settings. The attentional deficits ordinarily seen with mildly handicapped students are not observed when students are using the computer. When engaged in computer learning with peers, engagement in mainstream settings is relatively high. Group activity does not produce a high degree of off task behavior. Ethnographic interviews and observations suggest that the high level of group use is a strict economic distribution of students and machines. The demand is so great that it is dictating grouping patterns.

The rate of teacher contact and monitoring of students while on the computer is very low. Data from studies indicate very clearly that error rates are high, above twenty percent. The possibility is that we are engineering students to attend to high error rates. In the lab, students are responding impulsively. They are being reinforced by the continuous feedback. Instead of prompting reflectivity, the software being used may be reinforcing impulsivity.

A research team is studying the implications of working in groups. The kinds of relationships that develop from a communications point of view have implications for the current concept of engagement. It is likely that automaticity issues will be reduced if another student provides the correct resopnse in a problem solving situation.

David Malouf, of the University of Maryland, described the research on the effectiveness of microcomputer technology being conducted at the Institute for the Study of Exceptional Children and Youth. He gave an overview of the studies completed and then discussed research designs and issues encountered.

The studies of microcomputer effectiveness are being conducted in a large suburban school district primarily at the elementary level with some work at the middle and junior high level. Two descriptive studies have been completed. The first naturalistic study was to identify special educators in the district who were using microcomputers and to conduct observations and interviews. The second descriptive study was focused on the difficulties learning disabled students have in learning to use word processing. Two additional descriptive studies are in progress. One is looking at successful strategies students use with computers and the other is a study of students working at the computer in groups.

Several experimental studies were conducted to compare computer versus non-computer learning. A structured observation study compared computer drill and practice to seat work type drill and practice. A study of perceived mastery compared the same task presented on the computer and off the computer. The impact of computer assisted drill on achievement was a study comparing drill and practice on and off the computer. The "composing stories" study looked at the processes and products of writing in one computer condition and two non-computer conditions. Computer versus computer studies compared computer games with drill and practice on subsequent student motivation. A latency study compared retention on computer-based learning tasks.

Malouf reviewed some of the findings and issues identified by the researchers. He pointed out the difficulties in large scale naturalistic research that yield a large amount of data. He suggested as a research strategy, more focused descriptive studies. For example, the study of students using word processing resulted in rich information and a manageable amount of data. It provided information on those learning problems that are amenable to training and those which are more persistent. The findings give direction for further descriptive and experimental studies.

A structured observation involved the same students working on computerized drill and practice and paper-and-pencil drill and practice. Three areas of student behavior were observed -- off task, system and on task. Attention to system included activities that were on task but had to do with the system rather than the content of the activity. Students were almost never off-task when working on the computer. The findings on "system time" have implications for the time allocated for computer use, software design and classroom procedures. A distinction should be made between time engaged in the mehanics of the system and the time engaged in learning the content. While observing students, teacher interactions such as help with content, help with system, off task, behavior management, were monitored. Teacher interactions were higher with students using the computer than with students doing seat work. There was also a greater amount of "system help" on the computer than on seat work.

One problem in conducting computer effectiveness research is that of variable confounds. Findings reported may be confounds rather than essential aspects of instructions. For example, in the observations study, researchers did not intervene but there were numerous variables operating in the classroom in addition to the computer. The computer was often physically removed from the group of students reducing interaction with peers. The learning activities presented on the computer tended to be of shorter duration than seatwork learning activities. The content of lessons also tended to be different. Not only was the computer physically removed, it was also curricularly removed. With variable confounds operating, it is not possible to clearly establish the effects of computer-based learning. The information gained in the observational study was valuable descriptively but not for explanation.

The issue of variable confounds led to a study of computer assisted drill on achievement. Achievement, cognitive and affective factors were studied with an attempt to control some of the confounds. Control of experimental conditions is another issue. For example, in the computer condition students received immediate feedback. Feedback in the paper-and-pencil condition was delayed. One approach was to develop real counterparts in each condition such as providing immediate feedback in the paper-and-pencil condition. The study of computer games compared two conditions. One group was engaged in computer games the other group in computer based drill and practice.

Researchers examined the relationship between response latency and retention. There is ample justificaiton for recording a time element when monitoring student learning on a computer. In non-computer instruction the dimension most commonly used is rate. For computer-based learning researchers recorded latency rather than rate. In a study where students were taught a functional reading task of matching words with their common abbreviations, accuracy and latency were recorded with each trial. A long term retention test followed the training. Data was examined for systematic differences in latency between words retained and those not retained. A construct, the trial of last error, from the literature on latency, is the trial upon which the subject makes the last error prior to reaching a criterion. The latency before and after the trial of last error behaves very differently. Before the trial of last error the subject was still working on accuracy. On the trial after reaching criterion, accuracy decreased systematically. This finding should improve the ability to predict whether a student has learned the content.

An assumption in the survey research was that one of the critical functions a teacher performs is in evaluating and selecting software. A survey of 400 teachers reports less interest in the evalution instruction than in information provided by a colleague. In response to best methods for selecting software, the preferred method was to try out the software. Reviewing software evaluations was rated low by teachers.

Malouf concluded that in research on technology in education there is a tendency to look for simple answers to complex questions. He suggested that research was more likely to provide complex answers to simple questions.

SESSION 3: RESEARCH AND DEVELOPMENT OF SPECIAL EDUCATION AUTHORING SYSTEMS

Reports of three SEP-funded contracts to develop authoring systems for use in special education. The eighteen month projects are intended to provide tools for the development of microcomputer software for the individualized instruction of handicapped children. The principal investigators discussed the design of authoring systems and the issues encountered in development.

Joseph P. Lamos, Denver Research Institute
Marion Panyan and Paul Hazan, The Johns Hopkins University
Robert A. Zuckerman, Kent State University

Joseph Lamos of the University of Denver discussed the development of the H.E.L.P. Authoring System. Lamos indicated that his background as a systems analyst influenced the design of the educational authoring system. In 1970 Lamos was involved in the development of a large computer-based instructional system for the military. The system was designed to provide individualized instruction to compensate for lack of basic skills. There were similarities between the problems faced in educating that adult population and the problems of the mildly handicapped in school settings. One similarity was the importance of looking at the entire system including hardware and the cultural environment in which the system is will be embedded. Adapting principles of systems engineering, Lamos developed a notion of instructional engineering that involved a synthesis of research and theory in educational psychology and cognitive psychology. Part of that engineering perspective is that a functional analysis is necessary to determine the features a system needs to operate properly and to meet the requirements of the people using it. The other aspect of development is operational analysis. How is the system to be used and what are the constraints in the environment that may limit and inhibit the use of the product.

One goal was to design an authoring system that would move toward the principle of integrating special education students into the regular classroom. For that to happen, the product must serve the needs of both special education and regular education teachers working as team to meet the needs of children. The other aspect was to focus on how the microcomputer was integrated into the classroom situation. Data on computer use suggested that schools often begin with one machine in each classroom but eventually move to a centralized lab environment. That change in hardware location had to be considered in designing the system. Another aspect of the environment was that the classroom setting is activity oriented. That is, the teacher moves from activity to activity and the micro and the software had to fit into that way of operating. Typically the student is engaged in something for 15 minutes and then moves on to another task.

The authoring system was designed as a tool to allow people to adapt courseware to the learning needs of an individual student. Adaptation occurs at two levels, the micro-level in the sense of producing an instructional flow within the process of teaching a concept. At the higher, curriculum ordering level, it is necessary to reorder larger chucks of instructional material to adapt to individual learning requirements. An authoring system should have the flexibility to implement a variety of instructional strategies and also the capability to take a strategy and apply it across a variety of content areas. The system should engage the teacher in student management without overwhelming detail. The developer also needs to focus on organizations. Initially, schools should be able to use the system at a very basic level.

There are a number of ways to author CAI courseware. In designing an authoring system there is a tension between ease of use and flexibilty. The use of higher order language to design instruction is time consuming and difficult. Authoring languages offer another option. A modular authoring system has the capability to create small units of instruction that can be combined and used in a number of ways. In the H.E.L.P. Authoring System two levels are used. The first is micro-level authoring, where editors are used to structure the instructional strategy and design computer graphics.

At micro-level the idea is to create micro units, meant to provide instruction on a single concept. It is at this level that adaptation to the needs of the special student comes into play. Parallel micro units can be developed in a content area for different learning needs. The units are then collected in libraries. A micro unit involves the student in 10-15 minutes of interactive learning. Within a micro-unit the major element is a display or single visual field. Within the display are some standard presentation and and control items.

When designing an authoring system, there is a constant tension between the current and future needs of the organization. The H.E.L.P. system allows the schools to begin the authoring process at a basic level and to expand with their increased understanding of the system.

Marion Panyan presented an overview of the authoring system developed by the Division of Education and The Applied Physics Laboratory at The Johns Hopkins University. The purpose of the authoring system is to provide teachers with a tool that could be widely used to create lessons in discrimination, receptive language tasks, and basic reading and math skills. The system consists of 12 different lesson types. By varying items, numbers, letters, and words, different lesson types can be created. Once the lesson type is chosen, the next decision for the teacher is the type of instruction. By using the same lesson type but varying the text instruction, an entirely different objective is addressed. Teachers are able to create lessons by selecting text and graphics stored in the system. There are currently 96 graphics. An option for teachers to create additional graphics will be incorporated in the software. In addition to selecting the content of the lesson, there are important process and format variables to consider. Through a series of consecutive menus these decisions can be made throughout the authoring process. Another feature of the system is the student recordkeeping function. Two types of data are collected for each student. The first type provides information on accuracy of student performance. In pilot tests of the system, teachers have not found those data very useful because they are not graphically portrayed. It does not give them enough direction to compose or construct the next lesson. The second type of data is a trial-by-trial analysis. These data help to determine a position preference or other error type. The program can then be adjusted accordingly.

One of the principles guiding development of the system was teacher acceptance. Representatives from eight counties in Maryland and one in Virginia and Pennsylvania were invited to use the system and complete a field test report. Participants were asked to indicate experience with computers ranging from first time user to more than 6 months of experience. For those never using a computer, the mean time to author their first lesson was thirty-five minutes. For users with more than six months experience, the mean time was 12.5 minutes. However, this difference between the two groups was no longer observed after several consecutive uses of the system.

Teachers had two general recommendations for improving the system. First, teachers expressed a need to create their own graphics to correlate with the classroom program. They felt this capability would provide more compatibility between computer-based and regular instruction. Second, the system provides no explicit session-by-session data on student gains. The solution appears to be to collect information on selected variables and pair this with summary data in a manner that is useful to teachers. This data would be provided on a number of parameters and offer decision making points for the teacher.

Single subject designs could be used to examine the effects of the authoring system. Response time, percent of trials correct and trials to criterion would be dependent measures. Instruction, content, feedback, and reinforcement selections would be potential independent variables.

Teacher performance could also be monitored to determine whether they were responsive to available data and changed the lessons as needed. The authoring system is easy for teachers to use. There is also a need to develop a data system that would be as easy for teachers to use.

Paul Hazan of the Applied Physics Lab at Johns Hopkins indicated that one of the keys to success in this project was the use of an interdisciplinary team. The authoring system was to be a tool that could stimulate the creativity of the users. The team started out by assessing current approaches to authoring and identifying the strengths and weaknesses of existing systems. As a result of the assessment of existing systems, one key feature was to design a system that was easy to use. The needs of learners were established and the technical options evaluated.

Several features were considered in designing the system. The ability to add graphics and to select and vary reinforcers was considered essential. While authoring, the user can recall key information from previous screens and preview a single lesson or a sequence of lessons. A maximum of ten lessons can be held in memory for preview and editing.

The ability to design adaptive feedback to student response is another feature of the system. Other considerations built into the system are auto responses, help features, and editing capabilities. In creating a lesson, the author can visualize and edit content as well as create material from scratch. The system provides a step-by-step approach for ease of learning. Once the system is learned the user can author at a faster rate. The system was designed for the 64K Apple. In that way schools can make maximum use of the authoring capabilities with minimum hardware configuration.

In summary the authoring system as a vehicle for research as well as an instructional tool was emphasized. The use of the authoring system to examine process and content variables on learning rates and patterns was illustrated.

Robert Zuckerman of Kent State University, discussed the design of the SPE.ED. Authoring System and the alpha and beta test procedures employed as an integral part of the software development.

The purpose of this project was to develop an authoring system that would allow teachers with little or no programming experience to design courseware for computer-assisted instruction of handicapped students.

The design of the authoring system was to take advantage of teacher expertise allowing them to develop courseware efficiently for use by handicapped students. One major feature incorporated in the design of the system was the capability to modify the run-time environment of courseware for students of differing abilities/handicapping conditions. By design, to utilize the authoring system in the most effective manner, the teacher needs to identify 1) what content the students are to know, 2) how the students are to know the content and finally, 3) how instructional content is to be presented. The SPE.ED. Authoring System is a tool to assist teachers to mediate interactions with their students. The authoring system facilitates the development of the presentation of instructional content for purposes of introduction, practice, or testing.

The goal in developing the authoring system was not to have all teachers using the computer in their classrooms but to provide a tool that would allow teachers to design computer-based instruction without having to learn a high level programming language. The SPE.ED. Authoring System was designed to allow teachers to develop courseware which could provide a match between the process skills of the student and the instructional content of the curriculum. The ability to develop courseware that is appropriate for the process skills of the student is to avoid common sources of why software fails. Inappropriate content in available courseware and courseware content that the student has already mastered reflect the lack of appropriate instructional match between student process skills and the instructional content of the courseware.

Authoring is viewed as a two stage process. In the first stage the teacher is responsible for selecting the appropriate content and identifying how the content will be delivered. In the second stage the authoring system is employed the vehicle for organizing and entering the content presentation/interaction into a form that is "played back" by the student. The authoring system must provide as much flexibility as possible to create different kinds of lessons.

There are some trade offs in developing a user friendly authoring system. For instance, the developer has to decide how much prompting or error recovery to provide. Prompting and error recovery are costly in terms of the space required for the code versus the amount of space required for the program itself. In addition, the speed of a program will be greatly effected by the amount and manner in which prompting and error recovery are implemented.

The concept of "frame" is utilized in the SPE.ED. Authoring System to develop courseware. The frame is a unit of instructional interaction consisting of frame type identification, text/image to be displayed on the screen to the student, question type for query frames, correct response/answer for query frames, and exit path targets. A variety of different frame types are available to vary the instruction interaction available. Many different strategies for instructional interaction by careful selection and sequencing frame types. The frame type concept is "menu driven", different options are available for different tasks in the instructional process.

The SPE.ED. Authoring System was designed to avoid a number of pedagogical errors that often find their way into courseware product. In authoring systems that do have pretest features many do not force the teacher to avoid the violation of "pretest assumptions." For example: during a pretest new content should not be introduced nor should practice or testing take place. A pretest is used to identify what the student knows at the point in time the pretest is taken. Many authoring systems do not have pretest features.

In the SPE.ED. Authoring System the user has the option to incorporate a pretest. When selected, the results of a pretest can be used to branch the student anywhere in the lesson. The courseware author is responsible for determining branching patterns and targets followed based on the evaluation student's responses on the pretest. Pretest questions do not allow branching based on student responses. While constructing a pretest frame selection is limited to frame types pedagogically appropriate under a pretest condition.

When the courseware author indicates they are finished constructing the pretest, they then have access to a complete variety of instructional frame types. The manner in which the SPE.ED. Authoring System limits the design choices during the authoring process helps the user to structure the presentation of material.

The software development phase relied upon tests of reality constraints. The developers tried not to impose limits too early in the design process. A metafile structure was developed for the authoring system as well as a uniform approach to the concept of globals. Through the globals employed in the SPE.ED. Authoring System many features can be added enhancing the courseware functions served. The future integration and use of graphics is accessed through a global entered during the authoring process. The metafile structure allows transportability. Courseware files developed under one operating system can be transferred to run under another by transfering the file to the disk format employed by the OS.

A two stage beta test involving specialists and teachers will be conducted. Specialist can provide information about the speed and efficiency of the system. Users will keep a log of anecdotal data over 15 sessions and then complete an evaluation of the system rating the usefulness in developing computer based instruction, the features used, and other evaluation data. The logs will provide information for revising the software and will also confirm the system design.

The alpha testing of the SPE.ED. Authoring System was a formative evaluation procedure and was viewed as an integral part of the software development process. The overall design of the software was conceptualized, an IPO analysis and a "three-level analysis" that served as the software design reference were developed. As routines were coded, alpha testing was used to detect logic and coding errors. As routines were integrated, alpha tests revealed any descrepancies in the conceptual design and the actual performance of routines. The alpha testing indicated that the access routines and other elements of the software were consistent with the design concept.

Questions of product impact on handicapped students and their teachers will be undertaken after the product is disseminated in final form. In the Beta Test, information about the performance of the SPE.ED. Authoring System will be obtained. The Beta Test will be conducted in two waves. In the first wave, subjects will be "special interest, special skilled users" who can provide commentary and feedback on the technical aspects of the authoring system. Subjects in the second wave will represent the target audience for the authoring system. Characteristics of these users include rudimentary knowledge of computers, and minimal programming skills. One of the key factors and issues in conducting beta tests is to maintain a distance from the individuals who are using the software and hardware products developed. Another issue that arises is when should investigators contact beta test participants in order to elicit the response?

The authoring system will be in the public domain and technical assistance will be available to users.

SESSION 4: MAJOR TECHNOLOGY-BASED RESEARCH INITIATIVES

The Educational Technology Center (ETC) is the first of 17 laboratories and centers funded by the National Institutes of Education (NIE) to focus on technology education. The Center's task over a five-year period is to find ways of using computers and other information technologies to teach science, mathematics and computing more effectively. Dr. Jackson discussed the Center's research agenda and current research investigations.

Gregory Jackson, Educational Technology Center, Harvard University

Dr. Gregory Jackson, of the Educational Technologies Center at Harvard University, spoke about three research projects currently being conducted by the Center: Heat/Temperature, Videodisc, and Word Processing. He concluded with some background information on the Center, and the underlying philosophy of technology-based research.

The premise of the Heat/Temperature study is that part of the reason students don't understand key concepts in science is due to a gap between observation of what's happening and their ability to see the relationship. The question raised was: Can technology be used to help bridge this gap? In the case of Heat/Temperature, heat is an extensive quantity and temperature, an intensive quantity, and the distinction between the two is obscure. Students tend to get bogged down with the experimental process and they miss the cause/effect relationship. If students could have immediate access to what the relationship is, they might better understand the concept.

The Center decided to investigate the problem because it met four predetermined criteria: (1) teachers felt it was a hard concept to teach; (2) students felt it was hard to learn; (3) if the concept isn't understood, it's hard to progress in science; and (4) it led to an interesting idea of how to use technology to make such things easier to teach/learn.

A device was developed that would use a probe to measure the temperature of water and display the values on an Apple screen, either singly or on a graph against time. Immersion heaters were used to add measured amounts of heat to water. Teaching units with and without the equipment were developed, and pilot tests were run.

Teams sent out to collect evaluative data heard much negative feedback regarding how the experimental lessons ran. But pre-test/post-test results indicated that students working with the equipment gained twice as much understanding of the concept. The researchers learned the following: (1) there are many details involved in bringing technology motivated by curricular interest to the point where you can study how well it pays off; (2) you must be very careful how you measure success, as it is not necessarily equated with hapiness; and (3) even if an experiment didn't go well, the technology may have helped.

The second project discussed was the use of interactive videodisc to help students in developing hypotheses rather than just testing them. Eighty percent of users of interactive videodisc systems today are training operations in industry and the military. Existing programs are generally of two types: menus of different episodes of traditional CAI programs that branch based on student performance. If interactive videodiscs come to schools at all, they are not likely to be much different from training programs currently in existence.

Working in conjunction with the Children's TV Workshop, episodes from "3-2-1 Contact" and "Nova" are being adapted for use on Interactive videodisc. The disc is currently in production and includes five episodes. It will be tested in six junior high science classrooms next fall.

The third project, the Word Problems Project, was developed by the co-director of the Center. He was interested in the structural differences and methods of teaching word problems, and in the differences students and adults have with word problems. Discussions with teachers proved that their perceptions of the difficulties were quite different from his. For over a year, these issues have been discussed without any mention of technology. The main thing learned so far is that often in order to come to a productive use of technology you need to understand the issues of the subject matter being taught. If they are not clear, you can't expect technology to clarify them and solve the problems. Discussions have moved toward how to get computers to move from simple to complex concepts, to expose students to all type of word problems, and how to use computer graphics to build images that explain concepts such as miles per hour and density. No experimental work has been done yet on this project.

The three research projects were selected as representative examples of what the Center is doing. The interactive videodisc project is in the area of new technology -- what is likely to be important over the next few years but isn't important now. The Center also looks at existing technology in the teaching of math (Word Problems), science (Heat/Temperature) and computing.

The Center came about in response to a request for proposal (RFP) from NIE. The RFP called for a Technology Center to solve national problems in math, science, and computing, and serve the New England region. It was to be a collaborative effort with most research being done in the schools. Technology was recognized as being important, but had not yet become a focal point at Harvard. The Center proposal became a means of focusing attention on research in educational technology.

One of the first governing principles in the Center's research is that technology rarely raises new issues, but rather forces us to look at older, underlying issues presented in a new guise. A second principle is that technology should be approached from the subject matter. Instead of asking what a machine can do and then finding a place for it, researchers should find out what isn't going well educationally and determine how the machine can help. The third principle is that the Center and all of its research projects, should be collaborative efforts. The Center comprises some twelve organizations liked by subcontracts. Hopefully, these working relationships will continue beyond the 5-year scope of the project. The research groups have generally agreed on issues, underlying theories, appropriate research questions, and ways to proceed.

The Educational Technologies Center currently operates 12-14 research projects. They run conferences, training institutes and seminars, and publish two newsletters and periodic reports. Their primary charge is threefold: First, to determine under what circumstances it makes sense to use technology in general education; second, when it is appropriate, to decide what else has to happen; and third, to raise the level of discourse and cause people to think about technology in a different way and to integrate it into bigger issues. The lasting effect of technology will be through deep uses rather than superficial uses which motivate students temporarily, and then pass away.

SESSION 5: THE USE OF ADVANCED TECHNOLOGIES IN SPECIAL EDUCATION

A presentation by COSMOS Corporation on a fifteen-month, SEP-funded study to identify current research in robotics, artificial intelligence, and computer simulation and to explore the potential applications of these advanced technologies in special education.

Gwendolyn B. Moore and Elizabeth A. Lahm, COSMOS Corporation

Gwendolyn Moore and Elizabeth Lahm, from the COSMOS Corporation, discussed a 15-month study on advanced technologies. The project, funded by SEP, examined three technologies -- robotics, artificial intelligence and computer simulation.

The two project objectives were: (1) to identify how and where these technologies were being used in settings other than in special education; and (2) to determine which of the technologies might hold promise for special education students.

Liz Lahm explained three underlying methodological approaches: technology-push, demand-pull, and hybrid. The "tech-push" method focuses on the technology. A product is developed assuming there will be a market for it when it's ready. The main problem is that such products may not directly address the needs of consumers. Conversely, the "demand-pull" method begins with the consumers needs and products are developed to help meet those needs.

The "hybrid" method, developed especially for the COSMOS study, combines parts of the other two methods. Existing applications of the technologies are identified in fields other than the target field. Then forecasts are made regarding future uses of the technology in the target field. The "hybrid" approach focuses on the application rather than the consumer or the technology itself.

The steps in the hybrid approach include defining the technology and locating its uses, documenting uses in an alternate field, developing descriptions of similar uses in special education, rating those descriptions, and sharing findings of the study with potential users and developers.

The three technologies selected for study were robotics (which simulates human motion), artificial intelligence (which mimics human reasoning and perception), and computer simulation (which mimics human sensory experiences). Applications range from industry to home and school settings. Some 55 state-of-the-art applications were identified through the literature and through interviews with knowledgeable experts. Subsequent examination led to the selection of 17 cases for further study. Additional information was collected through site visits and extensive telephone interviews.

Gwen Moore discussed the research questions, the findings of the panelists, and the preliminary conclusions of the study. Each of the 17 cases was presented to a panel of ten special education technologists. The following questions were answered by the study:

1. What special education populations will benefit by each type of technology?

2. In what activities will each type of technology assist special education populations?

3. How many years will it take before each type of technology will benefit 10, 50, and 90 percent of the special education population?

4. What factors inhibit the implementation of each type of technology?

5. What dollar investment will be necessary to implement each type of technology for special education populations?

Tables, showing data responding to these questions, were shared with the audience.

Based on the panelists ratings and other materials examined during the study, the following conclusions were presented:

1. Robotics was thought to be most beneficial to the physically impaired while simulation would be of more benefit to the mild and moderate mentally handicapped and learning disabled. Responses for AI were more diverse, with two applications benefitting multiple populations.

2. The activity most frequently accomplished through robotics would be manipulating objects. AI would best aid one's understanding. Simulation would be most helpful in experiencing things without the inherent dangers.

3. The panel felt that computer simulation would be the technology most likely to reach special populations first. The 5 scenarios in that area were all projected to reach 90% of the population in 10 to 20 years. It was projected that robotics would reach 90% of end users in 15 to 19 years. AI again had the most diverse responses, with one application reaching 90% of end users within 15 years and other applications reaching only 10% after 15 years.

4. The biggest barrier to implementation of both robotics and simulation was expected to be cost. In the area of AI, training and technical difficulties were expected to pose the most problems. This was because the scenarios would involve complex systems for which there are no relevant models in current day practice.

5. The technology expected to cost the most to implement was AI, partly due to the large databases needed to support such systems. Four of the 5 scenarios were rated at over $500,000. Three of the 5 computer simu-

lation scenarios fell between $200,000 and $400,000, with the remaining 2 rated at over $500,000. Only one of the robotics scenarios was ranked in the highest category. The other two were rated between $100,000 and $300,000.

The final report on the study is still being revised, so the conclusions presented are to be considered tentative. First, there is a great diversity of applications and uses of all three technologies, so generalizations about the technologies must be made with care. Second, there are many lessons to be learned from the current applications of the technologies in other fields. Several of these applications are technically feasible today and pose little or no problem for adaptation to special education. Other applications will face significant cost, technical, or substantive barriers. Many of the barriers need to be addressed through uses of the technology in other settings, not just in special education. It is unrealistic to think that the special education community will be able to take the lead in surmounting the obstacles. This doesn't make the use of these technologies in special education impossible, but it does extend the timeline.

We must be careful not to let the technology overshadow the needs of the students. In cases where a technology could be used, we need to ask if it is indeed an improvement over the alternative ways of addressing the same need. And regardless of the setting, the technology should be meeting a real need as well as enhancing the education of the student.

SESSION 6: REPORTS OF RESEARCH IN PROGRESS

Brief reports of current research investigations by eight of the symposium participants. The researchers discussed the purpose of their study, the design and methodology, and the findings of their investigation.

Susan Jo Russell, Technical Education Research Centers
Raymond G. Romanczyk, SUNY-Binghamton
Rick Brinker, Institute for the Study of Developmental Disabilities
Richard D. Howell, The Ohio State University
Ron Thorkildsen, Utah State University
Philip M. Prinz, The Pennsylvania State University
Roger Awad-Edwards, Palo Alto VA Medical Center
Al Cavalier, Association for Retarded Citizens

Susan Jo Russell of the Technical Education Research Center, discussed findings from the survey component of a project called Microcomputers in Special Education: Beyond Drill and Practice. The project focuses on non-drill and practice uses of the microcomputers with students in grades K-8 who are classified as having either learning and/or emotional problems.

The term learner-centered software, used for non-drill and practice applications, was defined as uses of the computer where: (1) students make choices about the goals of the activity or about the strategies used to reach the goal; and (2) the feedback the user receives from the computer is informational rather than judgemental.

In planning the project there was a need to put activities in context. More information about the state-of-the-art in the use of learner-centered software with this population was needed. The predominance of drill and practice software was well documented but information about the characteristics of people who were using software other than drill and practice and the barriers to implementing drill and practice were not well documented. The question guiding the research was - Why isn't there more tool use of computers?

The survey had two components. The first was a random sample of 50 school districts across the country selected from all districts using computers for instructional purposes. The second part was a selective survey of individual teachers or systems that have promising uses of learner-centered software.

Russell reported on the results of the first part of the survey. The topics covered were the types of applications, strategies for helping teachers learn about computers, barriers encountered, factors facilitating use, and outcomes or benefits for students. Telephone interviews were conducted with special education administrators in each school district. A follow-up interview was conducted with a teacher in the district nominated by the administrator as being experienced and knowledgeable about this kind of computer use.

The administrators, in 83% of school districts reported drill and practice as the primary use. About one-fourth of the administrators reported using word processing software with students. This is the only tool software mentioned. There was no mention of databases or spreadsheets. Few administrators could give details on how this software was being used or why. Almost all administrators said the school system had provided some form of training, usually designed for regular education teachers.

Teachers were identified by administrators as barriers and as facilitators. One-fifth of the administrators talked about staff resistance as a problem while more than one-fourth indicated that staff enthusiasm was one of the ways things were getting started. Administrators and teachers both mentioned lack of good software as a primary problem.

The most interesting thing about administrators was what they said about benefits. In general, administrators had very little idea of what the possible benefits were. Stated goals were not found in any school district. A large number of the responses were of the type: "The reason we're using computers with our students is that it's the wave of the future, we can't be left behind." The other benefit most often cited was motivation. Forty percent said computers were used because they might motivate students. Very few administrators mentioned any sort of learning outcomes.

The teacher interviews confirmed and also expanded these findings. Because something was classified as non-drill-and-practice, did not mean that it was being used in a non-drill-and-practice way. There were instances where word processing was used to copy spelling words or to write sentences for spelling and not in any other way. Only one-quarter of the teachers used word processing as a writing tool. Problem solving software, such as LOGO, was often used as a reward when other work is finished. It was not viewed as a learning tool.

The second thing that became clear with the teacher interviews was that there is a very low knowledge base about what is possible, what computers can be used for. People simply didn't know what spreadsheets or databases were. The third finding that became clear was the inappropriate nature of the training most teachers had received. A large number had received training in programming and BASIC. None were using programming with their students. The few who had learned in an informal setting from a peer (teacher, student teacher, family member) expressed most satisfaction with their training. Teachers did not describe the lack of training as a barrier. Only 6% indicated lack of training as a barrier. Lack of resources was a very major barrier mentioned by one-third of the teachers.

The survey raised several questions that require further research. For example, what distinguishes people who use learner-centered software from those who use only drill and practice? Most teachers started with drill and practice. So the question is for those who went beyond; what were the factors. It seems to relate more to the literature about successful managers and entrepreneurs than to the educational literature. A second question is what alternative training models might be effective.

Finally, how do we cope with the lack of curricular fit. There is a pervasive sense that the way people are using computers is outside the curriculum.

Raymond Romanczyk of the State University of New York at Binghamton reported on two studies conducted at the Children's Unit for Treatment and Evaluation. The first study involved seventeen children diagnosed as schizophrenic, autistic, and severely emotionally disturbed in a visual discrimination task. An errorless learning paradigm that had a teacher and a computer condition was used to present the task. Researchers tried to control for every variable other than the presence of the person. For instance, if a touch sensitive screen was used in the computer condition, a stimulus card behind a sheet of plexiglass was used in the teacher condition to duplicate the tactile stimulation. Each child was run through both conditions to counter balance and control for sequence effects. A very high quality voice synthesizer was used and the teacher was provided timing instructions as to the pacing of the session.

Basically, no differences were found between the effectiveness of the teacher and the computer for this particular population. That finding was in contrast to previously published research. However, there were individual differences. Some students did better with the teacher or the computer. Behaviors like self-stimulation, acting out, and maladaptive behavior were significantly less under the computer condition.

Classroom measurements of predictor variables were taken to determine who would benefit. The findings indicate that the strongest predictor was a simple one. Classroom observation of child noncompliance to task direction indicates that the higher the noncompliance, the better the student does with the computer. In general noncompliance appears to be very strong. This may indicate escape motivated behavior and the interaction of learning history. One related finding in the literature is that for autistic individuals, self-stimulation appears incompatible with learning. That is, the more self-stimulation being engaged in, the less likely the child is to acquire the information being presented.

The correlation between errors and self-stimulation with the teacher was .77. With the computer the correlation was .04. So this characteristic associated with autistic individuals is present only under certain conditions. With all diagnostic groups there were signifcant correlations between patterns of self-stimulation and errors with the teacher. No group showed significant correlations with the computer for the same two variables. This suggests the need to rethink some of the supposed relationships between behavior, performance and learning. Social learning history may be confounded with the specifics of the learning task.

The second study involved generalization. Using simple mathematics tasks, researchers asked the question "what happens when we use a more functional task?" The paradigm was to pretest children diagnosed as severely emotionally impaired. The teacher then presented flash cards and worksheets followed by computer instruction. It was a three level program. At Level 1 problems were presented with counting prompts. At Level 2 counting prompts were presented only after errors. At Level 3, no counting prompts were presented. There was great variability in number of sessions conducted and no significant correlation with performance. For four out of five subjects, the generalization to flash cards was good. However, for the fifth subject pre- and posttest scores were almost identical.

Generalization to worksheets was also good and performance much improved from baseline except for fifth subject. That student exhibited the same pattern of generalization but still had high performance on the computer. This was a child who was very fearful of any contact or feedback with adults. She had acquired skills on the computer but there was a whole learning history that was preventing generalization from taking place. This example underscores the potential of computers as diagnostic tools.

Another study involved learning disabled students in math instruction taught by teacher and by computer. Concurrent psychophysiological measures were taken in both conditions. There was no difference in measures of rate and accuracy between teacher and computer until a simple token reward condition was added. The token condition raised performance. When the reward system was removed, the performance of the computer group fell apart. However, performance with the person maintained. This finding implies that computer variables as manipulations may be very fragile and caution is addressed in applied settings.

Given the software used and the findings, the researchers are proposing some standards as minimum for data collection in CAI programs. Archival data of each session such as, date, session time and duration are collected. Distinctions between presentation time of stimuli versus time spent in responding to stimuli versus consequence time are made. Parameter controls such as the duration of presentation, number of sessions, problem boundaries, feedback, voice presentation, reinforcement type and schedule, and presence of prompts are routinely collected. Data collection on these parameter control permits generalization of findings.

Rick Brinker discussed a contingency intervention project conducted at Educational Testing Service. The purpose of the project was to make handicapped infants explore their world. Infants in the study were organically impaired. That is, there was an organic condition associated with their handicap. The two factors associated with the organic conditions were a reduction in movement patterns which made it more difficult to contact objects in the world and a social system problem. Parents had not received positive information about their child's capabilities. The microcomputer provided the capability for a quick turn around of information and helped in handling the expectencies of the social problem. Parents could see a graphic portrayal of behavior following the intervention.

The microcomputer was viewed as a prosthetic device. The infants studied did not hold an object in their hands or bring the object to their face, and they had no visually directed reach. An understanding of objects is a very important basis for symbolic development. That understanding comes about through contact with and manipulation of objects. In the intervention, investigators prosthetically arrange an environment that would make consequences and objects perceptable to children. In this environment the child could see that a consequence was directly related to their own activity. The purpose of the prosthetic environment was to encourage the infant to explore. If a child is in a situation in which he controls interesting consequences, the child learns to explore and to control consequences.

In the literature on learning it is difficult to find a model for analyzing that level of data with an individual subject. Most of the infant learning literature is of group comparisons where control and experimental groups receive some series of similar stimulations. It's difficult to work at the level of single subject design and to look for learning on a daily basis and design the next intervention. The experimental design used first established a baseline where infants activity (pulling, hiding, vocalizing) was counted. Then one of the activities is made to produce consequences. Later contingencies are reversed.

The developmental hierarchy is described by Piaget as the development from primary circular reaction to means/ends behavior and is usually completed by eight months of age. First, the infant learns that they can make things happen. The next step is a secondary circular reaction in which the infant controls in a specific way. The final level is the sequencing and subsuming behaviors as tools to explore other consequences. Once an infant has visually directed reach and is exploring the world of objects the infant no longer needs the reinforcement environment.

The microcomputer also provides access to an archival database. Contingent probabilities are used to see how frequently an infant at different phases of learning emits an arm and then a leg response in a given contingency. Alternating responses would make sense in early sessions while subject was still exploring. The frequency of alternations decreases over time, and there is an immediate increase in alternations when the contingency is changed. That increase indicates exploration.

Ten moderately handicapped subjects received between two and eight months of intervention. Each made at least a one month gain in mental age per month in the intervention situation. There are some parallels between these findings and findings with school-aged children. An example is the potentially negative effects of reinforcing students for a high error rate or reinforcing impulsively. The capability to maintain computer-based data provides a clearer performance base on handicapped students, and gives a much clearer description of performances than ever before.

Richard Howell of The Ohio State University discussed a series of investigations focusing on CAI use with mildly handicapped, learning disabled students in the area of mathematics. He indicated that the question is not so much whether CAI `works, but where drill and practice belongs in the educational process. Almost 60% of programs used in special education are drill and practice based. CAI software can be modified in terms of rate, the difficulty of problems presented, and in terms of the operations. There are several areas that require attention. First, educational games have a number of variables, a number of stimulus items (graphics, sound, display, characteristics) that should be studied. Second, the focus of most software is not on altering the strategies by which the learner approaches the task, but rather on the manipulation of content related items by the learner.

In the pilot study, a single-subject, ABAB type design was used to determine if a common form of drill and practice software was an effective intervention for the acquisition of multiplication facts by learning disabled students. The drill and practice software used did not feature any strategy-based learning. Data gathering involved recording the number of errors per ten problems and the amount of time on task during each observational session. The data points represent an average of both errors and time over sessions. The baseline recording was done by a random sample of multiplication problems presented to the student using pencil and paper. The intervention was done by observing students performance as they answered ten randomly generated problems. The latency between presentations and problems was held constant.

The independent variable was an experimental procedure introduced in the first intervention period. Researchers looked at strategies students were using to solve problems. In solving multiplication problems, children were using a base five reference to approximate a number. The use of a base five referent point effected latency and also increased the possibility for error. The intervention involved thirteen sessions. The baseline period lasted 3 sessions and was followed by 3 days of intervention. A return to baseline condition followed. The final intervention period lasted 4 sessions.

The average number of errors per session increased from 1 in the first baseline session to 4 in the second baseline session. During the first intervention the drill and practice software was introduced. The subjects used the software for twenty minutes and errors decreased to 1 by session 6. After the baseline condition was reintroduced the error rate increased.

The results indicate that drill and practice software may have an initial but transitory effect on the number of errors and the amount of time required to successfully complete multiplication problems. It appears that without a specific intervention treatment that changes the strategy with which the student approaches problems, any gains made during the computer interaction will not hold over time.

The directions for future research seem to indicate the need to use CAI software that introduces a strategy for solving multiplication problems within a tutorial-based framework. The software may have a drill and practice compenent as a reinforcement strategy. Subsequent studies will introduce a new compensatory strategy using CAI in tutorial-based software. The child will work to a plateau, maintain that level, and then move to the next level with the compensatory software.

Ron Thorkildsen described the Social Skills Training Program developed at Utah State University. The Social Skills Training Program teaches cooperative interaction skills. Skills include getting involved, being involved, and being positive. Strategies for remaining calm in negative situations are also taught. Effective communication attributes such as use of correct intonation, correct body language and appropriate vocabulary are integrated into the skill areas.

The Social Skills Training Program used the videodisc to present examples of appropriate and inappropriate behaviors in the target skill areas. In addition to the videodisc there was print material with the program. At the outset of the project the intent was to present all information in a videodisc format. After five field tests with interactive videotape, it was decided that print material was preferable to a computer or videodisc screen when information presented was to be read.

The program is designed for small group instruction in upper elementary resource rooms. Materials are based on a direct instructional model. In the field test phase, teachers worked with five students. The teachers used the videodisc to present examples of social skills. After each example, there was a discussion of the scene presented. The videodisc was also used for imitation and structured role-playing.

A behavior management system is an integral part of the program. The four month field test involved pretesting, implementation of the program, and posttesting. Six classrooms were randomly assigned to the treatment or control group. There were fifteen students in each condition. All schools had some kind of social skills behavioral management system. The control group had no additional social skills training.

Naturalistic observations and sociometric testing were used throughout the four month process. Observers looked at negative, positive, and alone behaviors. Resource room students spent most of the day in regular classrooms. The sociometric testing was conducted in the regular classroom. All children in the class made a list of classmates and indicated who they like to play with most and least. In sociometric nominations students were asked to list the 3 people they liked most and least. Self-esteem testing, using a behavioral checklist, measured changes in specific behaviors and criterion checklists measured skill learning.

The sociometric testing revealed some differences. A comparison showed statistical difference (three-fourths of a standard deviation) between the experimental and the control group. Something was causing students in experimental group to be better accepted by their peers. There was no difference in self esteem between groups and very little difference on the behavioral checklist. However, there was a large statistical difference on criterion checklist. The students did learn the skills. Teachers reported little difference in behavior in peer interactions.

In the naturalistic observations, the control group started out a lot higher and more positive than the experimental group. Trend analyses showed the control group dropping and the experimental group going up significantly. The interaction between the repeated measures and the treatment was significant.

Thorkildsen predicted increased group use of computers and videodiscs. It is a good use of a scarce resource that works better in a lot of situations.

Philip Prinz of the Pennsylvania State University described the development of a computer/videodisc-based system for teaching written language, reading, writing, and general communication skills. The basic philosophy underlying the development was that reading and writing should be taught in an interactive mode and written language in a discourse or conversational mode. The microcomputer/videodisc was used as a tool at the interface of written language instruction and general communication instruction.

The project, called the ALPHA Interactive Language Program involves special education teachers, speech and language pathologists, LD specialists in classrooms and resource rooms. The primary target group was hearing impaired children. The program started with a preschool population and expanded to include elementary aged hearing impaired students. A pilot study was also initiated with multihandicapped children who had severe communication (expressive output) problems.

A language/reading assessment battery was used for pre- and post-testing measurements. A modes imitation test or sentence imitation test sampling various modes - American sign language, finger spelling, simultaneous communication, spoken English and speech only was administered. Once the primary mode of communication was determined, all other subtests were administered in that mode. There was a single word receptive and productive vocabulary measure, a sentence imitation test, a grammatic comprehension measure, and a generalized vocabulary reading test in the battery. A teacher and parent language communication questionniare and direct observations of communication interactions in the classroom provided additional information.

In general, results indicated no gains in reading level but large gains in the use of computer hardware. In terms of written language and general communication, children make significant gains not only in terms of reading vocabulary acquisition but also specific gains in general language. Researchers also studied the interactions between the teacher, child and computer. The interactions were videotaped and the structural and functional aspects of the interactions were analyzed.

The current research objectives include determining the effects of microcomputer instruction, the amount of instruction time, and the effects on the development of written language. A second area of interest is the effect of the location of the computer in relation to achievement. The effects of classroom versus resource room placement are contrasted. Another area of study is the impact of computer generated sign language on learning. Children receive half of the test items with the sign language graphic and half exluding the graphic.

In the videodisc study the researchers will contrast computer generated graphics and video excerpts. Classroom teachers will be involved in inservice training and the effects on language and written communication will be measured.

Roger Awad-Edwards described the work of a multidisciplinary team at the Rehabilitation Research and Development Center of the Palo Alto VA Medical Center. The purpose of the project was to establish the concept of using an industrial robot, enhanced with voice recognition and voice synthesis capabilities, to restore lost upper body functions to individuals. The goal was independence for both the physically disabled patient and the caregiver by augmenting, supplementing or replacing lost function. The team seeks to demonstrate the feasibility of this concept technically and as a methodology for examining the relationship between smart machines and people.

The system consists of off-the-shelf hardware and customized software that is frequently adapted. The development of a human/robot team drew from many disciplines -- psychology, critical path analysis, education, and human factors. The first step was to establish the parameters involved in a voice controlled robotic aid termed interactive robotics. Safety is a critical issue. There are several ways of addressing safety, including software modifications, redundancy of safety stops, and emergency stop procedures.

The methodology developed is termed interactive evaluation. It consists of four prototypes that assess technical and clinical parameters simultaneously. The assessment is done in a cyclical fashion. Milestones provide direction and guidelines for future research, information, products, software, and principles that can be transferred to subsequent development. The superstructure includes the analysis of robot factors and human factors for organizing the research.

In order to generate a humane/machine profile, researchers assess the machines performance and it's impact on human characteristics. In turn certain human performances dictate requirements for current and projected technology. Potential users, quadraplegics, are involved in the development and design phases. for our analysis included robot factors, human factors for organizing our research.

Three stages in the development of the interactive evaluation prototype were: feasibilty, utility and potential marketability, and diffusion of innovations. A major goal of the project was to assess user acceptance and how it can be facilitated. The users identified four major categories of tasks for which they would like a robotic aid. One of the tasks was a meal serving task. They also wanted the robot aid to help in vocational tasks such as opening file drawers and retrieving files. Recreation was another category. For example, real time voice-control and preprogrammed motions can be used for painting.

The approach used was an androgogical, not a pedagogical one. Ninety-five percent of the work was done with adults; individuals whose sense of self direction is a key factor in using an aid. They want immediate not delayed application of learning. Five training sessions, 60-90 minutes in length, orient users to the robotic aids. At the end of every session there is a standardized proficiency task that provides tangible outcomes. For example, the first standardized task is to give yourself a drink of water. There is also a program of peer training. The present voice operated system has 50 commands and is speaker dependent. The key to success with voice control is achieving consistency with the voice.

The concept of robotic aids has been extended to include robotic technology for health and human services. A three phase study using interactive and silent observation, is being conducted in a nursing facility. Robots are used primarily as a tool. It was demonstrated that older people in nursing homes could use this technology. Other applications include transporting, lifting patients, ambulation, and vital signs monitoring. An attitudinal assessment of health care professionals and technological engineers was incorporated into the study. Researchers found positive attitudes if the professionals are properly oriented to the technology.

In the future, a project for using this technology will be conducted to determine the extent of crossover from the current population to school-aged populations.

Al Cavalier, Director of the Bioengineering Program at the Association for Retarded Citizens indicated that national ARC has a good field network that defines needs for researchers. A thrust in the last few years has been to increase independence the most severely handicapped persons allowing them to participate in community living. One of the limiting conditions frequently identified is a fundamental one of independent toileting. Incontinence is also a serious problem for individuals with higher order skills employed in vocational programs. Individuals are often denied access to these programs because of lack of control for independent toileting.

The study of incontinence is focused on individuals who fail to learn complete independence in toileting and do not have related medical or organic problems. Typically, training programs usually involve increasing the level of fluids and thereby increasing the opportunities for learning to take place. The subject is then taught a series of behavioral steps and through phasing and physical guidance can achieve a criterion. The stimulus is internal and focuses on a single point in the toileting process.

Technology can be used to increase the speed with which a toilet training program achieves success. The application is a good example of technology used temporarily to impart a skill that a client can learn and then removing technology from the situation. There is also a larger application to individauls who have a permanent loss of ability to sense and control bladder function.

There is a theoretical base for this development effort. The toileting sequence involves stimulation in the bladder, the elimination response, and the consequences. Clients have to attend to three sets of stimuli and they are attending to only two. The technology is designed to assist with the stimulus that is lacking. By continuously monitoring the condition of the bladder, the technology senses the fullness of the bladder for the person. It is a redundant cue.

The model has three components: a sensor on the body, a black box or main logic unit, and a feedback device. The feedback device returns an external signal to the client. The model uses technology to externalize an internal stimuli for a short period of time. That external stimulus is redundant with the internal stimulus. The educational research in discrimination learning indicates that a relevant redundant cue can be faded as learning takes place. The logic unit has a signal that amplifies the signals coming from the transducer on the persons body. The signals are echoed back to the logic unit by body tissues to determine whether an external stimulus should be provided. The sensor must be placed on the body to have an unobstructed internal view to the bladder.

The ARC researchers are working with untrasonic scientists at NASA to map out bladder locations in varying body types and to determine the variation between a full and a not-full bladder. The first phase of development is to define the parameters of where the bladder is and what occurs when it is full. A prototype using these measurements will be developed and alpha tests conducted. The logic unit will then be reduced to the size of walkman cassette recorder. The client will wear the unit attached to a belt.

With the powerful advances in sensor technology, eventually the sensors will be reduced to the size of a bandaid that can be peeled off a strip. These advances will make devices far more flexible and easy to use. The research program has selected two field test sites, a vocational program and a public school special education setting.

Market research suggests a wide range of use for the device. It is estimated that in addition to 100,000 people with mental retardation, there are five million persons that have bladder problems who could use the aid. One area that has long plagued behavioral psychologists can now be assisted with the use of microprocessor-based technology.

SESSION 7: FUNDING FOR TECHNOLOGY-BASED RESEARCH

A panel presentation on funding for technology-based research with representatives of government agencies, foundation and industry funding resources. The panelists discussed current program initiatives and alternate funding strategies.

Mary K. Leonard, Council on Foundations
J. Richard Taft, The Taft Group
Edward Esty, NIE/SBIR
David Gray, NICHD/SBIR
Richard Johnson, NIHR/OSERS
Martin J. Kaufman, Director, DES/SEP/OSERS

Mary Leonard, Director of the Precollegiate Education Program at the Council on Foundations, discussed trends in the foundation giving and grant seeking strategies. The Council on Foundations is a membership organization of approximately 1000 charitable foundations and corporate giving offices. Council staff does research on the field of philanthropy and provides professional development for staff and trustees of foundations. Other components are a strong lobbying program and an active public information program.

Leonard described some trends in foundation giving. First there has been a slight expansion in the dollars available for foundation giving. The dollars available for education have increased 8.5 percent from 1983 to 1984. There is also a large expansion in the number of grant seekers. Historically, foundations have funded in higher education institutions. Several years ago 96 percent of the money going to education went to higher education. Foundations are increasingly more apt to give to public institutions. There is also an increasing sophistication in the development business. The hiring of professional grant seekers and development officers by institutions is more common. Foundations are trying to become more sophisticated as well. The Council encourages members to become more focused in their grant seeking. There are more cooperative grants or grants shared by a number of foundations. Foundations are also looking very favorably at consortiums of organizations such as a local school system and a local university. Challenge grants are another increasingly used tool. These grants increase reliance on outside sources of funding in addition to the foundation or corporate dollars. Foundations are targeting their money more carefully. The field of philanthropy is trying to professionalize itself. There are about 24,000 private foundations. Only fifteen hundred are staffed and most at a level of two or three persons. Foundations are interested in learning more about both the subject matter of grantmaking programs and the process of selecting, evaluating and providing technical assistance to grantees. We are also seeing more interest in the corporate sector. There is an increase in corporate matching gifts programs. Finally, we see an increase in the provision of noncash assistance. Corporations are moving into the area of program related investments, they will lend money for a development project. Other foundations are using their auspices to convene meetings of interested parties. They are providing technical assistance for new, grassroots organizations.

Leonard reviewed some of the basics of foundation funding. The most basic piece of information for grant seekers is to get to know The Foundation Center. The Center is a sister organization to The Council on Foundations. It is set up to provide information about foundation and corporate giving to the grant seeking public. The Center provides the information needed to approach foundations successfully. Leonard advised grant seekers to contact funders early on, before a project design has been determined. This gives foundations an opportunity to provide input in the development phases. It is helpful to develop a brief synopsis of your work that presents the information in a precise, comprehensive way. It is also helpful to contact multiple funders. Funders expect this. Finally, it is helpful to a funder to be informed about the progress of your project. When approaching any funder, do your homework first. It is very impressive to an organization if you know as much as possible about them and what they do.

TAFT

Richard Taft, President of the Taft Group, provided a perspective about the philanthropic field in general and some tips about fund-raising. He indicated that only about five percent of all proposals submitted to foundations get funded. Funding at the federal level runs about eighteen percent. One thing that is important to grasp is the magnitude of the funding industry, the diversity of that industry and its complexities. There is 74 billion dollars a year in private philanthropy in this country. Non-profit organizations, of which there are about 800,000, constitute a large percentage of our gross national product. Taft pointed out that the competition in the fund-raising business has been intensive under the present administration's emphasis on private sector activity.

Funding by foundations and corporations is only part of the business. The bulk of the money comes from individuals. Approximately 62 billion dollars comes through bequests, contributions to charity, and major gifts. Individuals are the big factor in the philanthropic field.

There is a strong professional element to the foundation and corporate field of philanthropy. Often successful fund seeking is based on contacts, who you know and the relationships you develop. Foundations break down into five areas. There are the big general research foundations like Rockefeller, Ford and Carnegie. They ususally have sizeable assets, holding 60-70 percent of all assets in the foundation field.

There is another group called special purpose foundations. They have chosen to concentrate in one particular area such as health care or education. There are over 20,000 family foundations. Essentially these foundations are extensions of one individual's philanthropy. Another kind of foundation is the community foundation. It is generally a group of trusts at the community level, administered by community leaders. Corporate foundations are extensions of corporate giving. Two types of funding in corporations are direct giving and through foundations. Another way to develop funding is through endowments. Individuals and family foundations with a special interest in the area often endow a research project. It offers a tremendous potential for funding.

Grantsmanship is a process of market research. Proposals are not the best route. In most cases you begin with a concept not a proposal, then contact the foundation, and develop a dialogue. The one thing to remember is it's easier to get a hearing if you have contacts in the foundation. Foundations give to people and to ideas. The way to demonstrate that you have a good idea is to explain in a short letter or executive summary. A proposal is in a sense a hinderance to the process of communication. It cuts off the dialogue and discounts the foundation's expertise.

ESTY

Ed Esty, Director of the Small Business Innovative Research (SBIR), the Department of Education, spoke on funding available under that program. The Small Business Innovation Development Act was passed in 1982. Essentially the law says that any federal agency with an extramural research and development budget of more than a hundred million dollars a year is required by the Act to set up a Small Business Innovative Research Program. There are now twelve such agencies; the Department of Education is one of them. The percentage of money to be set aside changes from year to year. In the first year, FY83, .2 percent was set aside. This year it is a full one percent. All participating agencies set up a three phase program.

In Phase 1 people are given a small amount of money for six months, to demonstrate or determine the feasibility of an idea. Proposers must be small profit making businesses of 500 or fewer employees. People who compete successfully for Phase 1 contracts are then eligible to compete for Phase 2 funding. Awards are limited to two years and average about $200,000. Phase 2 involves conducting the full scale R&D that has been determined in Phase 1 to be feasible. The third phase is not ordinarily funded by the federal government but by other sources of venture capital. A document called The Pre-Solicitation Announcement provides information on the program in all twelve agencies. It comes out quarterly and lists the agencies having competitions, the release date, and the technical topics that the agency is interested in. All solicitations from the twelve agencies are very similar in format, making it easier for small businesses to be involved in more than one competition.

GRAY

David Gray, of The Human Behavior and Learning Branch of the National Institute of Child Health and Development, talked about that agency's funding programs. NIH consists of eleven institutes and has numerous mechanisms for funding. One is the Small Business Innovative Research Grant and Contract Program. Each year there are three cycles of funding under this program. The role of the program officer is to review the initial two or three page synopsis of an idea and to set up a mechanism for tracking the proposal.

The Human Behavior and Learning Branch is currently working in the area of learning disabilities and encouraging people to develop software for diagnosing and treating reading problems. Another area is the development of software or educational materials for exceptionally bright children. A third area of interest is prevention of accidents and promotion of health.

JOHNSON

Richard Johnson, of the National Institute of Handicapped Research in the Office of Special Education and Rehabilitative Services, discussed the institute's priorities. NIHR supports research in all areas of disability, primarily in those age ranges that relate to rehabilitation. All NIHR grant announcements appear in the Federal Register. Johnson discussed several pending announcements. One is for rehabilitation and training centers to work in the areas of elderly disabled, improvement of independent living programs, rehabilitation of psychologically disabled persons, and community resources. Another current announcement is for a rehabilitation engineering center on technology for blind and visually impaired persons. Three research and demonstration programs on delivery of rehabilitation engineering services, computer adaptations for severely disabled people, and economics of disability will also be funded.

NIHR has innovative grant programs to test new concepts or methods of working with the disabled and to purchase new devices and evaluate them for use with different disabled populations. An annual field-initiated program funds research and demonstration programs which have a direct bearing on the development of methods, procedures and devices for the disabled. A unique program at NIHR is a research fellowship program of grants to individuals rather than institutions. The five priority areas in this program are community retardation services, transition and employment, early intervention, medical research and disability statistics.

KAUFMAN

Martin Kaufman, Director of the Division of Educational Services in the Office of Special Education Programs, gave an overview of SEP directions for the coming year. He indicated that the field-initiated research program will be announced earlier for next year. According to SEP's projected schedule, the notice for the training, demonstration and, research programs of the Office will be issued toward the end of July.

In addition, SEP will probably focus on two broad target areas next year. One area is likely to involve collaborative work between researchers, school systems, publishers, and hardware providers on the issue of technology integration. The purpose is to find examples that integrate technology into the classroom and demonstrate that integration is possible. In the short run, examples of effective technology integration are needed in the literature. A second area is likely to target on advanced technologies for use in making augmentative devices or services available to low incidence populations who currently are not receiving the benefits of existing technology. The issue is of access to devices and the need to stimulate ways of making devices more available to handicapped individuals.

RESEARCH SUMMARIES

SUMMARIES ARE ORDERED ALPHABETICALLY

Philip Archer
* Roger Awad-Edwards
Michael M. Behrmann
Randy E. Bennett
* Richard P. Brinker
Colleen A. Haney Bruno
  (See Egolf)
** Douglas Carnine
Phillip Cartwright
* Al Cavalier
E. William Clymer
** Richard Deni
  (See Brinker)
Donald B. Egolf
** K. G. Engelhart
  (See Awad-Edwards)
Gail Fitzgerald
* Mark B. Friedman
Robert Gall
** Bud and Dolores Hagen
Carol Hamlett
* Ted Hasselbring
Jacqueline Haynes
* Paul L. Hazan
  (See Panyan)
** Alan Hofmeister
* Richard D. Howell
Jeffrey W. Hummel
* Kathleen M. Hurley
James Jurica
  (See Howell)
* James A. Kulik
* Elizabeth A. Lahm
  (See Behrmann, Moore)
* Joseph P. Lamos
Charles MacArthur
Gail McGregor
* David Malouf
Beth Mineo
  (See Cavalier)
** Judy Moll
* Gwendolyn B. Moore
Catherine Cobb Morocco
June E. Morris

Doris Naiman
Susan Neuman
(See Morocco)
Linda E. O'Donnell
* Marion Panyan
* Philip M. Prinz
* Herbert Rieth
* Raymond G. Romanczyk
Teresa Rosegrant
* Susan Jo Russell
Regina H. Sapona
Gilbert Schiffman
(See Panyan)
** Ken Seeley
* Melvyn Semmel
Jack M. Spurlock
Richard Steele
* Ron Thorkildsen
** Greg Turner
Michael Wolfe
John Woodward
(See Carnine)
* Robert A. Zuckerman

* Individuals who made presentations
** Individuals who submitted Research Summary but who were unable to attend.

STUDY Identification of Effective Implementation Strategies for Integrating Microcomputer Instruction into Ongoing Services for the Handicapped (Project INTERFACE)

SUMMARY "Project INTERFACE" is based on the premise that effective communication in special education will come only as a result of understanding the most effective implementation strategies for microcomputer usage and its capability to help special education students. The purpose of this 2-year collaborative project between BOCES/Long Island University (LIU) and local education agencies (LEAs) is to determine the most effective implementation strategies for integrating microcomputers into ongoing educational services for the handicapped. The objectives address specific issues directly related to the project's purpose.

Objective I - To determine those contextual and behavioral variables required for effective integration of microcomputer technology into ongoing educational services for the handicapped.

Objective II - To develop and maintain mechanisms for the participating institute of higher education (Long Island University at C.W. Post Campus) and the Intermediate Educational Agency (Nassau County BOCES) to synergistically integrate their research and training offerings.

Objective III - To develop and maintain demonstration practicum sites within a school of the Nassau County Board of Cooperative Educational Services (BOCES) and local school districts which will incorporate those contextual and behavioral variables ascertained in fulfilling Objective I.

Objective IV - To determine the impact of a collaborative training effort on the performance of teaching and administrative trainees in special education.

Objective V - To develop and implement mechanisms for the two collaborative programs (Nassau BOCES and Long Island University at C.W. Post Campus) to disseminate information on the project's research and training efforts and results.

More specifically, in the first year of this study, field investigation and interviews were conducted to provide important descriptive data and documentation of the most effective practices for integrating microcomputer instruction into ongoing education services for the handicapped. In the second year of the study, these "most effective practices" will be implemented and demonstrated in practicum sites located within schools serving the handicapped. In addition, a collaborative effort with LIU for the training of school personnel at these practicum sites will take place. Lastly, in the final project months, a large scale collaborative dissemination effort related to contextual and training requirements necessary for the effective integration of microcomputer instruction into ongoing education services for the handicapped will be conducted.

RESULTS

The grant is now in Year One. Data is being collected and analyzed. However, we feel that findings associated with this grant will concentrate on:

1. The need for leadership and formal structures that facilitate efficient planning and decision making at all levels within a district.
2. Ways to introduce computers into the schools.
3. Agreement on specific kinds of training to meet the needs of different types of teachers.
4. The particular skills and competencies that special education professionals ought to have in the use of computer technology.
5. Strategies for teaching these skills.

FUNDING SOURCE

U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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ARCHER

STUDY The Impact of Microcomputer Instruction on Handicapped Children

SUMMARY The purpose of this project was to study: (1) the effectiveness of microcomputer instruction in promoting the learning of handicapped students in a school setting; and (2) the organizational and administrative requirements associated with implementing a microcomputer-based instructional program in a large school setting.

The evaluation objectives were to: (1) determine the effectiveness of different types of microcomputer instruction on the readiness/achievement of preschool and elementary students according to level of cognitive development; (2) determine the effectiveness of different types of microcomputer instruction on the behavior of preschool and elementary school students according to level of cognitive development; (3) determine the effectiveness of different types of microcomputer instruction on the problem-solving ability of preschool students according to level of cognitive development; (4) determine the effectiveness of different types of microcomputer instruction on the general cognitive ability of preschool students; and (5) determine the administrative, organizational, and logistic requirements of implementing microcomputer instruction as associated with student learning.

Students in one preschool (ages 3-5), two early elementary schools (5-8 years), and one upper elementary school (ages 8-11) received computer instruction for three 30-minute periods a week. There were 120 students in the preschool and 41 in the building's elementary program, 115 and 127 in the two early elementary schools, and 196 in the upper elementary school. Instruction took place in each school's Learning Center which housed Apple and Texas Instruments microcomputers. Students were randomly assigned to three treatment groups according to levels of cognitive functioning. Treatments consisted of Logo, instructional software (selected on the basis of students Individual Education Plans), and teacher-directed activities (control).

Preschool children were assessed by their teachers on selected subjects of the *Brigance Diagnostic Inventory of Early Development* and the *Classroom Behavior Inventory, Preschool Form* (Schaefer & Edgerton). Project staff administered individually the *Think It*

Through problem solving subtests of *Circus* and selected subtests of the *Kaufman Assessment Battery for Children*. Elementary students were given appropriate levels of the *Metropolitan Readiness Tests* and *Metropolitan Achievement Tests* in reading and math and were rated by their teachers on the *Classroom Behavior Inventory* (Schaefer, Edgerton & Aaronson, 1978).

RESULTS

Although there were significant differences according to blocks (levels of cognitive and linguistic functioning) there were no statistically significant differences according to treatment except for that between the Logo and control groups on the problem solving test. Logo students scored higher.

It is believed that the necessarily short treatment period (three to four months) contributed in large measure to the absence of significant differences. The 1984-85 year treatment period will be at least seven months so that findings will be more reflective of the nature of the treatments rather than of their intensity.

It was evident that Learning Center staff had had little exposure to Logo and received only rudimentary training from project staff. This year Logo specialists offered regularly scheduled training to Learning Center staff in order to insure that the Logo treatment is indeed representative of Logo as conceived by Papert.

The validity of the 1984-85 treatment period assures us that the findings, whatever they may be, will have important implications for the education of special education students.

Selected students who are representative of the designated blocks will be observed regularly by project staff employing the instrument developed during the first project according to Sigel's (1977) Model of Cognitive Distancing. Content validity of the project's Microcomputer Observation Instrument was established by relating Sigel's interactions between child/computer and teacher/child/computer. Sigel's original behavioral descriptions, which were derived from parent/child interactions, were videotaped and then categorized along a continuum ranging from low to high distance. Inter-rater reliability was also achieved by viewing videotaped lessons. Agreement of level and category was .80 among four trained raters. In this way the process of learning through computer instruction can be documented and compared.

FUNDING SOURCE	U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs
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AWAD-EDWARDS
ENGELHART

STUDY Training Methodology and Results for a Voice-Controlled Robotic Aid

SUMMARY When we began our research in 1981, there were no historical precedents; therefore, no established protocols for teaching individuals to use voice-controlled assistive devices such as a robotic aid. Within a new methodological framework (Interactive Evaluation) for evaluating prototype assistive devices, training procedures have been developed, standardized, and researched for a voice-controlled robotic aid. Training is important to the prototype evaluation research process because it (a) provides a mechanism for systematic collection of user feedback, (b) allows opportunity for depth and breadth of user input, and (c) is critical to acceptance of any advanced assistive device -- particularly computerized, interactive devices, such as a robotic aid. A fundamental premise of Interactive Evaluation is that potential users are directly involved throughout an assistive device's research, development, evaluation, and diffusion stages.

The Veterans Administration/Stanford University (VA/SU) Robotic Aid Project is the first system to incorporate a human-scale industrial manipulator with six degrees of freedom (Unimation PUMA-150), a standard microprocessor-based voice recognition unit (Interstate Electronics VOTERM), and synthesized voice response (Votrax), and to be driven by high-level software on a Zilog MCZ 1/25 microprocessor, using totally digital, multiprocessor-based algorithms.

User training on this system is accomplished in five sessions which are one to two hours in length. During each session, the user reviews existing expertise, acquires new information, practices the lessons in both structured and unstructured manners, and finishes the session with a task that helps the user assimilate the entire lesson. While we have trained users from age 5 to age 90, our approach is based on androgogical and pedagogical principals. Key concepts include self-directedness, learning readiness, immediate applicability, and problem-centered learning tasks.

Over 110 users have been trained to use the VA/SU Robotic Aid. A 200-page user's manual (containing

both self-paced and trainer-paced instruction) has been developed and utilized by people with widely varied educational backgrounds. These educational levels range from less than a high school degree to Ph.D.s, both technical and non-technical, and M.D.s. Feasibility of training a wide age, educational, and ability range has been shown.

Tasks for the robotic aid have been defined and studied in the following areas:

- personal tasks such as activities of daily living (ADL) including cooking, serving, salt shaking;
- recreational tasks such as board games and painting;
- vocational tasks such as opening file drawers, extracting files, and presenting them;
- therapeutic tasks to improve visual monitoring skills and range of motion therapy.

RESULTS

Proficiency levels for robotic use have been established based upon these task areas. All users learned to pick up a cup within one hour of their first introduction to the robotic aid system. Drinking, feeding, serving, cooking, picking up and placing and fetching tasks for a robotic aid were named by 90% of the quadriplegic respondents.

Development of standardized training procedures for instructing trainers is currently underway. A "peer training" program is also being developed to match user and trainer according to age or personal rehabilitation experience. Future studies are designed to assess the ability to optimize successful use of the robotic aid by matching a particular training style with a particular set of user characteristics.

FUNDING SOURCE

None Specified

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BEHRMANN
LAHM

STUDY Technology to Assist Young Multiply Handicapped Children

SUMMARY Two related research projects investigated the use of computer technology to enable young multiply handicapped children to interact with their environment.

The first study addressed the question of the minimal developmental levels (e.g. cognition, language) required for a child to successfully activate a switch controlled computer. The methodology included computer generated voice prompts to activate a switch. Response data were collected directly by the computer. Developmental ages, as recorded on student Early Learning Accomplishment Profiles, were collected. A multiple linear regression was used to analyze the relationship of developmental ages to achieving pre-determined mastery criterion for response time.

The second study evaluated the role and behaviors of the teacher, computer prompts, and the child, and the sequence of behaviors required to teach the skill of activating the computer with a switch. The behavior of all three were coded based on videotapes of teaching sessions. A lags sequential analysis was performed on the data.

RESULTS In the first study cognitive age was found to best predict mastery, with a developmental level of 11.4 months the minimal age required to master the necessary skill. This study shows that very young children can be taught to interact with a computer system. It shows the potential for using computer technology for early intervention in the area of environmental control for young multiply handicapped children.

In the second study, the findings indicated that the child achieved the skill without interaction with the teacher. Despite the achievement of the target skill by the child, teacher intervention continued. This second study raises numerous questions about the role of the teacher in that teaching process. Additionally, it illustrates that more thought must be given to the presentation sequence of the learning task to achieve efficient learning on the computer.

FUNDING SOURCE None Specified

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STUDY

AERA Editor-at-Large Program Liaison for Microcomputer Research in Special Education

SUMMARY

The AERA Editor-at-Large Program works to identify and publicize quality research in a variety of topical areas related to education. As the Program Liaison or "Acquisition Editor," for Research on Microcomputers and Special Education, I welcome hearing from researchers about their work in this area.

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BRINKER
DENI

STUDY

Handicapped Infants Exploration of the World: Building Persistence at an Early Age

SUMMARY

Contingency intervention is an approach to teaching handicapped infants that their behavior controls interesting environmental events, thereby building the motivation for exploring that environment. The microcomputer is used to: (1) control contingencies between behavior and consequences; (2) collect performance data to determine if infants are learning or have already mastered to relationship between their behavior and environmental events; and (3) provide summaries of progress so that teachers can decide to change the complexity of the environment to be explored. From a variety of theoretical perspectives, the process of learning to control simple consequences provides the foundation for human adaptation.

A review of research results demonstrates: (1) different patterns of learning by handicapped infants which characterize different styles of exploration; (2) significant development of moderately handicapped infants receiving contingency intervention; and (3) the feasibility of using contingency intervention as a process assessment tool for severely/profoundly retarded preschoolers for whom standardized measures did not provide meaningful information.

Currently, a small business, Contingency Software, Inc., has been funded by the National Institute of Child Health and Human Development to develop contingency intervention software for use by teachers in early intervention projects. Site selection criteria and project design for national field testing will be discussed.

RESULTS

The contingency intervention research demonstrates that, given the appropriate environment, handicapped infants as young as 3 months of age can discover that they control events. Moreover, once they have discovered a simple control rule they will not persist indefinitely emitting behavior and producing consequences. This breakdown of behavioral control can be explained in terms of cognitive models of habituation. Behavioral control and renewed interest on the part of the handicapped infant are re-established when a new contingency problem is presented. Thus even for handicapped infants Papousek's observations seems to apply: The primary motivation is to explore new problems and solve new contingencies. The implications of these findings could fundamentally alter our notion of *behavioral control* and its older sibling *compliance*. The absence of behavioral control may reflect the teacher's failure to detect the infants solution of one problem and to provide a new more challenging problem.

FUNDING SOURCE National Institute of Child Health and Human Development

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CARNINE
WOODWARD

STUDY

Computer Simulation Instruction on Health Facts and Problem-Solving Strategies for Learning Disabled High School Students

SUMMARY

The purpose of the study was to investigate the effectiveness of a health computer simulation in teaching high school mildly handicapped students basic health concepts and strategies. Thirty students from a Eugene high school were randomly assigned to one of two groups: (1) conventional health instruction and (2) a combination of conventional health instruction and the simulation. Each day, all students received the conventional instruction as one group for 20 minutes. For the remainder of the lesson, the conventional instruction group worked at a variety of extension and review activities. Each student in the simulation group worked at a microcomputer with Health Ways.

After 12 days of instruction, each student was given two posttests and an attitude survey. The Health Ways Nutrition and Disease Test was a 30-item test designed to measure retention of basic health facts and concepts from the written curriculum. The Health Ways Diagnosis Test measured the student's ability to prioritize changes in a person's health habits based on diet, heredity, current disease, and other essential health related information. The Nutrition and Disease Test was given again two weeks later as a measure of retention of the fact and concept information.

Both posttests were also given to a random selection of high school students from health classes. Their scores were compared with those of the two groups that participated in the study. Analyses of variance (ANOVA) and *t*-tests were performed on the data.

A properly developed computer simulation can produce more sophisticated problem-solving behaviors (related to analyzing lifestyles) in learning disabled students than is found in non-learning disabled students who are enrolled in regular health classes. These learning disabled students are now tutoring regular education students on health promotion, using the simulation. Wedding technology and analytic instructional design can produce substantial learning of complex skills in mildly handicapped students.

RESULTS

The major purpose of this study was to determine whether or not a computer simulation used in combination with a direct instruction approach to a health curriculum (simulation group) is more effective than the direct instruction method alone (conventional group). In the main analysis, these two methods are compared on two measures. A supplemental analysis further compares the performance of these two groups with students randomly selected from regular high school health classes on the same two measures.

Three separate 2 x 2 analyses of variance (ANOVAs) were performed on scores from the different sections of the Health Ways Nutrition and Disease Test. Analyses included: (1) the section of the test not reinforced by the *Health Ways* simulation; (2) the section of the test *reinforced* by the simulation; and (3) the total test. The analyses of mean scores of the two groups on the Nutrition and Disease Test given one day following and two weeks after instruction reveal a significant main effect for the instruction method on the total test score and on those items in the test that were reinforced by the *Health Ways* simulation ($p < .03$ and $p < .01$), respectively). The section where items were not reinforced was near significance (< .06). There was no significant interaction between instructional method and time of testing.

Five *t*-tests were performed on the posttest scores of the Health Ways Diagnosis Test. Scores for the conventional and simulation groups were compared in the following areas: (1) prioritizing alone; (2) stress management; (3) identifying health problems and making correlated changes; (4) total test score without stress as a factor; and (5) total test score. The findings reveal significant differences (< .001) in all areas.

In supplemental analysis, a one-way analysis of variance (ANOVA) was used to compare the test performance of the conventional and simulation groups with students from regular health classes who did not participate in the study. Again, scores from each section of the Health Ways Nutrition and Disease Test and the Health Ways Diagnosis Test were analyzed. On the Nutrition and Disease Test, only the section where items were reinforced by the *Health Ways* simulation showed a significant difference ($p < .01$). Total test scores were near the significance level ($p < .07$). All sections of the Diagnosis Test showed significant differences ($p < .001$).

FUNDING SOURCE U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs.

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STUDY Computer Assisted Instruction in Teacher Education: A Full Length Course

SUMMARY In addition to its main campus, The Pennsylvania State University maintains 17 other campuses where freshmen and sophomores complete the first 2 years of undergraduate work. Some majors, though, do not have faculty at all campuses and students must wait until their junior year to take their first courses in their majors. Although there are not educational faculty at some campuses, there is a great need to begin instruction in the field of teacher education before the third year of a 4-year program.

In response to that problem, the University has developed, evaluated, and implemented a series of modules and an entire 3-credit teacher education course which is offered completely by microcomputer. In addition, an innovative microcomputer-based procedure was developed to evaluate the extent to which students and inservice teachers have achieved certain competencies.

EDUCATING SPECIAL LEARNERS, a full length 3-semester hour course, is given by microcomputer as a "stand alone" course. All instruction is given by the computer through a series of computer modules. The modules are easily transportable to other institutions and use the following hardware: Apple II series (II+, IIc, IIe) and the IBM PC series (PC, PCXT, PCjr). For the past 2 1/2 years the course has been used successfully on 13 Penn State campuses. This computer-assisted instruction course can also be taken through Penn State's continuing education and correspondence programs.

A series of studies, conducted primarily by Professor Patrick Schloss, have focused on the following aspects of computer-assisted instruction: location of questions and highlights as a variable in computer-assisted instruction; efficacy of various ratios of questions and highlights to text; higher cognitive and factual questions; placement of questions and highlights as a variable in influencing the effectiveness of CAI; and focus of control of computer-assisted instruction. These studies have been conducted using the EDUCATING SPECIAL LEARNERS modules.

RESULTS Evaluation of the course was based upon three criteria: cost efficiency, academic achievement, and student acceptance. These three criteria have been met and exceeded. Evaluations were carried out internally at Penn State and by other institutions of higher education implementing the course. Currently, the course is in use in approximately four dozen institutions in the United States and Canada.

FUNDING SOURCE None Specified

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CAVALIER
MINEO

STUDY A Bladder Sensor for Persons with Urinary Incontinence

SUMMARY The goal of this 3-year project is the development and field testing of a portable ultrasonic bladder sensor to aid in the toilet training of incontinent persons and to provide increased independence for persons who have permanently lost the ability to control their bladders. The aid will continuously monitor the volume of urine in a person's bladder and then provide a subtle auditory, visual, or tactile signal when a threshold volume is reached.

The project is a collaborative effort of Association for Retarded Citizens of the US (ARC/US), the NASA Ultrasonics Team at the Langley Research Center, the NASA Biomedical Applications Team at the Research Triangle Institute, and the Medical College of Virginia (MCV). The project is divided into four major phases. During the first phase, ARC/US consolidated all available research information on urinary incontinence in the various handicapped populations into a computerized database which will be periodically updated throughout the project. In addition, this phase involved cooperations with MCV to determine the anatomical/physiological parameters for proper positioning of the bladder sensor. The second phase will involve the development and in-house testing of first a rack-mounted prototype and then a portable version.

During the third phase, the portable aid developed in phase two will be systematically evaluated in client service settings. This behavioral research will take place in the Dallas Independent School District and in programs of the ARC-Peninsula in Virginia to gather information: (1) on the durability, reliability and flexibility of the prototype; (2) on the utility of the sensor in providing increased independence in toileting; (3) for guidelines on the appropriate use of the sensor; (4) for credibility of the sensor's effectiveness and acceptance by researchers and practitioners; and (5) for the basis for eventual marketing. The final phase will involve the preparation, dissemination, and utilization of the project information and reports.

The anticipated implications of this research are:

1. More efficient and effective toilet training procedures for populations currently unable to be toilet trained using traditional techniques.
2. Greater independence and improved self-esteem for incontinent persons with a variety of handicapping conditions.

FUNDING SOURCE
U.S. Department of Education, National Institute for Handicapped Research

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CAVALIER
MINEO

STUDY Technology to Enhance Special Education: Remediation of Problems in Logical Thinking and Memory

SUMMARY Memory problems are believed to exist in the large majority of persons with mental retardation and learning disabilities. If deficiencies remain uncorrected they compound higher level areas of functioning and frustrate remediation attempts.

The instructional systems under development have been designed for use with two popular personal computers. The systems combine techniques for teaching efficient cognitive strategies with the unique characteristics of computers in logical analysis, memory, and motivation. Through an interactive format, the system first assesses the degree and type of memory process deficiencies and then provides individualized remedial instruction appropriate to the assessment results. The system also maintains a record of each student's performance for review by parents and teachers.

Field testing of the instructional system will be conducted in an attempt to answer five research questions:

1. Will the computerized version of the assessment/instruction procedure yield data similar to those derived from previous laboratory and classroom research;

2. Does the assessment identify memory problems;

3. What is the nature of memory problems evidenced by individuals with mental retardation or learning disabilities, and are there any differences between the two groups;

4. Do the instructional techniques employed assist in remediating the rehearsal deficiencies identified in the assessment; and

5. Do students generalize the use of strategies trained directly to instances for which they received no training?

Approximately 60 subjects matched for chronological age will serve as subjects. Twenty subjects with mental retardation, 20 with learning disabilities,

	and 20 nonhandicapped students will participate. Half of the subjects in each group will serve as controls while half will receive intervention with the computer-based instructional package.
RESULTS	The results of this research should lay a foundation for future work concerned with computer-assisted remediation of memory deficiencies. It will allow conclusions to be drawn regarding the appropriateness and effectiveness of computer-based interventions of this type.
FUNDING SOURCE	U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs
RESEARCHER	Al Cavalier Director, Bioengineering Program Association for Retarded Citizens of the US 2501 Avenue J Arlington, Texas 76006 817-640-0204 and Beth Mineo Project Director Association for Retarded Citizens of the US 2501 Avenue J Arlington, Texas 76006 817-640-0204

STUDY Instructional Development of Communication Training Materials for the Deaf

SUMMARY The use of educational technology is an integral part of the instructional development (ID) activities at the National Technical Institute for the Deaf (NTID). My work focuses on several areas:

1. Microcomputers as a Productivity Tool to Improve ID.

In what ways can the new technology improve the systematic development of special education curriculum? I am interested in applications of microcomputers by expert instructional developers and subject matter specialists to improve the efficiency and effectiveness of the instructional development process. The use of various productivity software is being investigated to improve the analysis, design, and evaluation stages of ID.

2. Authoring Languages.

Can authoring languages really facilitate the development of effective CAI? I have been investigating different types of authoring "tools" and have attempted to determine which are the most appropriate for use by classroom teachers at NTID.

3. Interactive Video.

Interactive video is an ideal instructional format for providing hearing impaired students with receptive communication training. NTID has used the DAVID system with success for speechreading and sign language instruction. Additional work is being completed on different subject areas as well as development of interactive videodisc applications. Program development using authoring languages is also being investigated.

FUNDING SOURCE None Specified

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STUDY

Use and Evaluation of Technology to Promote Communication in Nonspeakers

SUMMARY

The purposes of this project are to: (1) evaluate the interaction patterns between nonspeakers, using electronic communication aids, and their communication partners; (2) determine the interactive strategies that can enable nonspeakers to become more effective communicators; (3) teach nonspeakers these effective strategies; (4) conduct inservice training sessions teaching interactive skills to nonspeakers; (5) develop a graduate curriculum in the nonspeaking or augmentative areas; and (6) disseminate the results of the research to professionals, parents, and nonspeakers.

The implications of this research deal with the realization of educational, vocational, and social enhancements by nonspeakers using electronic communication aids. The research is designed to facilitate the realization by teaching nonspeakers effective communication strategies.

FUNDING SOURCE

U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs.

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FITZGERALD

STUDY Classroom Behavior Record: An Interactive Videodisc Training Program in Classroom Observation Skills

SUMMARY The Classroom Behavior Record (CBR), a classroom observation code, was developed in 1977 as a means to gather data of overt behaviors displayed in school settings by children referred to a psychiatric clinic. CBR is a 32 variable code used in 6-second timed intervals to record data on a target child of interest and his/her peers within the same situation. Two versions of this system now operate in Iowa: (1) data collected in a Datamyte or TRS-100 for processing via the University's PRIME computer system or via the microcomputer program, and (2) data collected on computer scoring scan sheets and processed via the Exam Service. Classroom behavior data has been collected on children with behavior and learning disorders over the past 8 years and used in research studies as well as clinical treatment evaluation.

We have now developed an interactive computer-videodisc training system to provide complete training on the CBR and observational procedures. The training side of the videodisc contains motion samples of classroom behavior, narrative descriptions, still frame examples and non-examples of each behavior, glossary information, and practice sessions ultilizing the Power Pad with a coding score sheet. The practice side of the videodisc provides extended motion samples of classroom behavior which can be used for practice and, we hope, reliability testing.

When the effectiveness of the interactive videodisc program is established, we expect to have a readily available, efficient procedure for training classroom observers. Presently it takes 40 to 60 hours of trainer time to bring an observer to the desired level of proficiency and reliability. We expect the videodisc program will reduce the time the trainee spends becoming an observer, and will nearly eliminate the need for an active trainer. The program will more adequately meet individual needs; there are often wide variations in the time it takes individuals to learn the code, in their abilities to code efficiently, and in their motivational commitment to learn. We further expect that the videodisc will help standardize the training and reduce observer drift over time. Establishing the effectiveness of this videodisc program as a "stand alone" training package will greatly increase its portability to school systems, teacher training institutions, and researchers throughout the nation.

Field test data will be compiled during the 1985-86 year on the relative efficiency and effectiveness of the videodisc program for teaching observation skills to an acceptable level of reliability. Training in observation skills will be incorporated into the graduate course of instruction in special education and school psychology and placed in field test districts.

FUNDING SOURCE	State of Iowa Part B, E.H.A. Discretionary Funds; University of Iowa Video Production Grant
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STUDY Computer Applications for Students with Behavior and Learning Problems

SUMMARY In a 2-year research and dissemination project, activities were undertaken to investigate special microcomputer applications in the curriculum for students with behavior and emotional disorders, and to provide related skill training to teachers. Research activities have focused on four areas.

1. When given a choice of classroom rewards, how popular is computer free time in comparison to other typical classroom rewards?

On a forced choice reinforcement questionnaire, and by actual choice, students with severe behavior and emotional disorders were found to select computer activities significantly more often than comparable free time or edible reinforcers. A follow-up study was carried out to determine the relative strength of computer activity contingencies on classroom behavior and work productivity when contrasted to a no reward condition and a free time/sticker choice condition.

2. How effective is computer-assisted instruction with students with severe attentional difficulties?

This study was designed to contrast computer-assisted instruction with traditional, drill-and-practice instruction among a sample of children experiencing attentional difficulties. Each student was given an individualized spelling test to form equivalent work lists for weekly spelling study. Half of the words were studied via a CAI program and half in a traditional structured paper-pencil drill format.

3. How effective are computer-assisted activities compared to traditional activities for teaching students problem-solving and impulse control skills?

A curriculum unit was developed to provide training on problem solving skills using self- instructional phrases, opportunities to practice with "safe" activities, and applications of the skills to social situations. Adolescent behaviorally disordered students in public schools participated in the study. While the teaching and application activities were consistent for both study groups, half the students practiced with computer activities (CAI) using simulation software and half with comparable non-computer activities (NC). Comparisons were made of their performances on the Means-Ends Test, Kendall Self-Control Rating Scale, and the Porteus-Mazes.

4. How do student cooperative work skills on computer-based projects compare to such skills on similar, non-computer-based activities?

Students in a psychiatric hospital setting worked in pairs on cooperative learning activities. A comparison was made of their work skills and interactional behavior while involved with computer-based and non-computer-based projects. Activities were matched as closely as possible and included cooperative solving of mazes, writing and illustrating stories, creating sound tracks for plays, and generating graphic designs. Analogue rating scales were completed by each teacher during the activity periods.

RESULTS

1. Students were found to be on-task more of their work time (88% compared to 55% and 63%) and to produce more work (130 correct answers compared to 95 and 77) under the computer reinforcement condition when contrasted to a no reward condition and a free time/stickers condition. These studies suggest that the contingent use of computer free time may be a condition and may be a popular and powerful reinforcer for students with behavior and emotional difficulties.

2. Findings over a 5-week period indicated that the two practice methods were equally and significantly effective in increasing the number of words learned over a no practice condition. This study suggests that children noted for having problems sustaining attention are not overly distracted by computer gadgetry and software features and can learn through CAI at a level comparable to more traditional methods. By having children spend some time on the computer, teachers will increase available time for individualized instruction.

3. Mixed results were found. The CAI group showed significant improvement on the Porteus Mazes and Self-Control Rating Scale, and the NC group demonstrated greater alternative thinking skill abilities on the Means-Ends Test. This study demonstrates that self-regulatory behavior can be enhanced by direct instruction and that computer activities can effectively be incorporated into such instruction.

4. The pilot study showed an increase in task involvement behaviors when working on computer-based activities. Mixed results were found on other behaviors being rated. A replication of this study in a severe BD public school classroom is currently in progress, with systematic observation data being gathered weekly by trained observers. These studies will evaluate the potential of using CAI activities to encourage cooperative behavior skills necessary for appropriate social functioning.

FUNDING SOURCE State of Iowa Part B, E.H.A., Discretionary Funds

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STUDY Eye Control: Using Vision as an Effector as well as a Sensory System

SUMMARY Although vision is one of our primary sensory systems, our eyes have always been used to communicate as well. Where we look during a conversation is one of the cues for nonverbal coordination of turn-taking during conversations. Similarly, others can "read" something about our emotional and/or attentional state by observing the size of the pupils of our eyes. Modern technology allows us to control computers and, through computers, to control robotic and environmental control systems with our eyes.

In special education, eye control of computer communication systems is a method of choice for many severely physically handicapped children. It allows them to communicate at relatively high speed for extended time periods without excessive fatigue. One commercial "spin-off" of eye movement research is the EyeTyper, a noncontact, eye-gaze-controlled keyboard. Some current research is directed towards using the eyes for "mouse" or "joystick" control of computer software. Other research is aimed at direct eye gaze control of target selection for robotic systems. The latter research promises to enhance manipulative control of the environment for the severely physically disabled. The use of eye gaze control devices may lead to subtle, unconscious changes in eye movement patterns.

In special education today, it is the communication needs of physically handicapped children that are being addressed by eye movement analyzing systems. In the future, the communication needs of severely emotionally disturbed children may be aided as well. One can consider modifying toys and appliances (television sets, doors, etc) to respond to being looked at as a first step toward interactive communication by those who are unresponsive to normal communication channels.

FUNDING SOURCE Personal resources and venture capital.

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STUDY

The "Prairie Post": A Microcomputer-Based Electronic Bulletin Board Serving Rural Special Needs Populations

SUMMARY

The objective of this field-based research project was to provide an opportunity to examine the efficacy of a cost-effective microcomputer-based electronic bulletin board system in helping to overcome the special communication difficulties encountered by educators serving special needs populations in rural areas. The venue for the project became the educational jurisdictions presiding in the rural region of Southwestern Alberta (Canada) bounded in the south by the American border and the west by the Rocky Mountains, and covering an area of approximately 18,000 square miles. The academic base for the project was the University of Lethbridge, and the mandate for the project was obtained from the Department of Advanced Education (Government of Alberta). It was identified as the Rural Special Education Outreach Project (RSEOP).

The Prairie Post is a computer-based information system -- commonly called a "bulletin board." Information is shared through the use of computers. Although it is not a new concept to the zealots in computer circles, it is seen as an innovation to many educators.

Conceived in the fall of 1983, the Prairie Post was launched in the summer of 1984 as a pilot of its parent -- Rural Special Education Outreach Project. The intent of the Prairie Post was to place teachers and administrators in rural areas in contact with the latest developments in special education. In addition, this relatively new medium would also allow the same educators to share information amongst themselves through the convenience of electronic networking.

Information regarding specific components of the Prairie Post, and appropriate data regarding modified interaction patterns resulting from the project, can be obtained from the author. The major components include these primary objectives:

1. To develop a regional physical network of hardware units, which would become the RSEOP Bulletin Board, and to establish a communications network among among them.

2. To share these units in a pilot phase of the

project between selected representatives of the teaching and administrative members of the school systems within the rural region of Southwestern Alberta, and to eventually extend these to parents and special needs children.

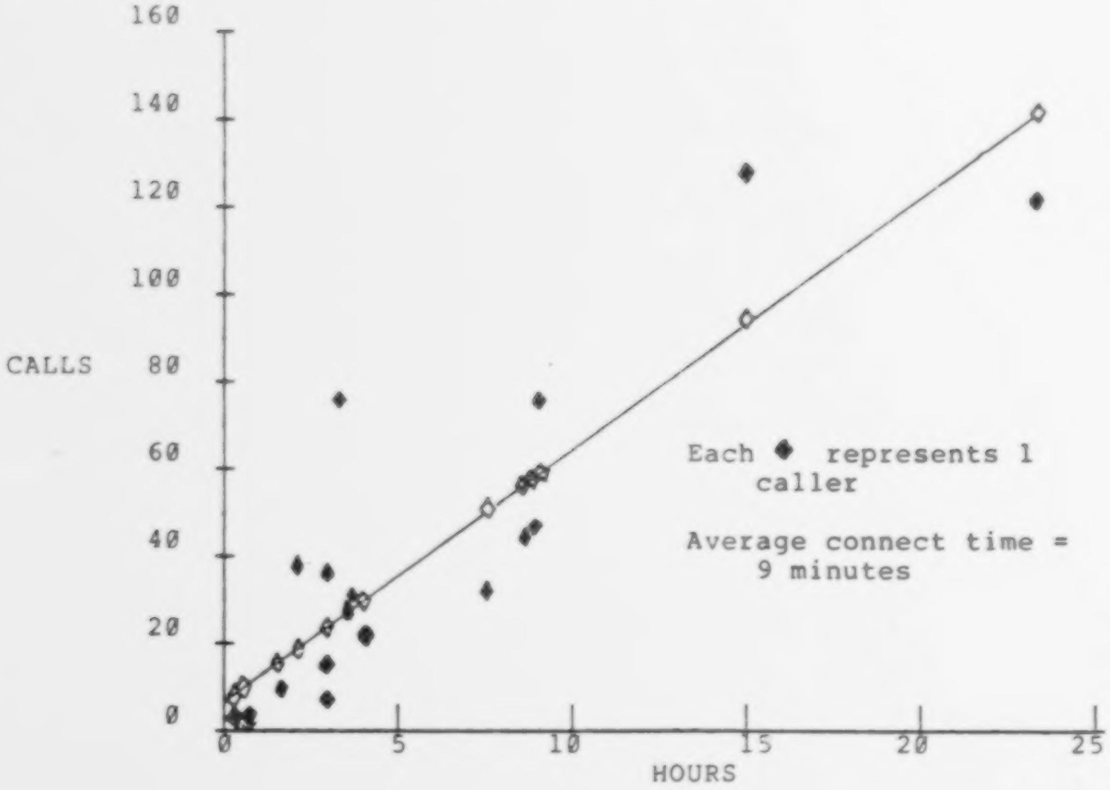
3. To "broker" information services available on information utilities such as SpecialNet and BRS-After Dark on behalf of the RSEOP pilot project participants, and to establish appropriate subscription contracts with these utilities.

4. To encourage the development of a variety of telecommunications applications through the RSEOP network, including electronic mail between participants and, externally, to the information utilities, consultation services among participants, university personnel, and the information utilities; and electronic conferencing between system participants on matters of common interest.

RESULTS The following schematic of on-line user access provides one sample of the callers access' frequency.

3/25/85

BULLETIN BOARD USAGE



Each ◆ represents 1 caller

Average connect time = 9 minutes

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STUDY Identifying and Using Authoring Systems for Special Needs Children

SUMMARY This study was designed to identify and use two "off-the-shelf" authoring systems useable with special needs children for language development; one in each of two classifications: simple-to-use mini authoring and more complex major authoring systems.

Phase One: Identify criteria for selection:

Considerations for Mini Authoring:

1. Useable with single disk drive Apple II Systems.
2. Cost
3. User Control
4. Large Type
5. Fixed Format/Menu Driven for ease of use by teacher, for simple Drill and Practice Materials.

Considerations for Major Authoring System:

1. Useable with single disk drive Apple II Systems.
2. Cost
3. User Control (no timing loops)
4. Large Type
5. Graphics Ability
6. Color
7. Speech Output
8. From full keyboard to single switch access

Phase Two: To implement use with two hearing impaired and six learning disabled students.

The methodology for choice was to examine commercially available authoring systems existing at the time (1981-1982) and to use those that came closest to the criteria standards.

The methodology for implementation was an independent study time extracted from regular study periods to include a minimum of 20 minutes per day. Measures of effectiveness included grade improvement, attitude and motivation of students as well as the scoring of actual courseware lessons.

Two authoring systems were identified: MICROQUEST as the mini authoring system meeting all of the criteria for selection; and E-Z PILOT as the major authoring system meeting (in its original form) 6 of the 8 selection criteria.

RESULTS

Implementation of these authoring systems was extremely successful with the two deaf students. A measurable improvement in vocabulary usage existed for all eight of the students. Improved vocabulary understanding with usage both written and oral was documented through grade improvement and actual courseware scoring. Motivational impact showed more aggressive participation in regular classroom activities as well as improved independent study habits using the vocabulary support software prepared through the authoring systems.

The use of authoring systems, such as the two used in this project, demonstrated the effectiveness of independent visual drill and practice for the two deaf students. The successful but less dramatic results in direct vocabulary improvement for the LD students created the desire to add speech to the software presented to the learning disabled students. This desire led to contact with the author of E-Z PILOT and the eventual inclusion of speech output through the ECHO II speech synthesizer. It also led to the use of the Hartley Cassette Control device and the ability to add tape recorded human speech to the courseware.

Based on the effectiveness of this project and others like it, the desire to make curriculum specific courseware created on E-Z PILOT available to other populations, such as severely physically disabled and the mentally disabled, arose. This led to a special version of E-Z PILOT that allows single switch entry through the game control port, either through touch sensitive alternative keyboards or the addition of the Switch Interface for common mini-plug switches.

The overall implication was the creation of a multisensory authoring system using low cost commercially available products: E-Z PILOT, ECHO II, Chalkboard, Hartley Cassette Control Device, Switch Interface, etc., all with the intention of making microcomputer-based learning materials accessible to all disability groups.

FUNDING SOURCE Private

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STUDY An Investigation of the Feasibility of a Microcomputer System for Developing Scanning and Selection Skills in Severely Handicapped Students

SUMMARY Electronic scanning communicators may be the most efficient alternative communication system for individuals with severe physical limitations. Scanning communication aids reduce the number and precision of motor movements required for a child to initiate communication. A primary disadvantage, however, is that the scanning process requires more sophisticated skills than direct selection. The user must be able to visualize his/her goal, to anticipate the direction of the cursor, and to anticipate the arrival of the cursor to the goal. Scanning may also negatively affect motivation because of the slowness of the technique. Some physically impaired children, particularly those who also have significant cognitive deficits, may require extensive training. Very little research has been reported which addresses the issue of effective training strategies for teaching children with severe handicaps to use electronic scanning devices.

The current research addresses the effectiveness of a microcomputer video game designed to train nonvocal severely physically handicapped students to make scan and selection responses similar to those needed for operating linear scanning augmentative communication aids. The video scanning and selection game systematically shapes scanning on more complex screens by slowly increasing the number of boxes presented simultaneously on the screen.

The primary study evaluates the effectiveness of the video game in increasing the number of correct scan and selection responses for each subject using a single subject multiple problem across subject design. Periodic probes are used to examine the degree to which scanning and selection responses transfer to a standard three symbol light scanning communication aid. A related study, using a Latin squares design, examines the use of three different cursor types by young (3-year-old) nonhandicapped students.

RESULTS The most significant implication of this research is for communication training for severely handicapped children with significant cognitive deficits. Many of these children who learn to operate a rotary scanning device have difficulty making a transition to more versatile and powerful linear scanning communication aides. One possible reason for this difficulty is that a rotary scanner provides additional cues to the child regarding the direction and speed of the cursor. Using a microcomputer for training would allow the use of intermediate training steps which retain the additional cueing of the rotary scanner while using the format of linear scanning. In addition, the flexibility of the microcomputer allows easy development of game formats to increase student motivation and interest during training.

FUNDING SOURCE Spencer Foundation

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HASSELBRING

STUDY

A Chronometric Analysis of the Effects of Computer-Based Drill and Practice in Addition and Subtraction

SUMMARY

Chronometric analysis has been used to verify a "Min Model" for solving single digit addition problems. In this model, a child adds two numbers, m and n, by setting a counter to the maximum value for the two addends (m,n), and then incrementing it the same number of times as the minimum value of the two addends (m,n). Using chronometric analysis, Groen and Parkman (1972) showed that most children have not memorized their basic fact tables and do not use reproductive memory to recall these facts, but rather, use reconstructive processes to generate answers using the Min Model.

The purpose of our current research is to determine if computer-based drill and practice can be used to enhance a child's memorization of the basic addition and subtraction facts, thus reducing the child's dependence on the more primitive reconstructive or counting process.

In the current set of studies, we provided mildly handicapped students with daily computer-based drill and practice in the form of arcade games over a 20 to 30 day period.

RESULTS

The results of these studies indicate that (1) almost all students increase their rate of correct responding as a result of the drill and practice; however, (2) few students move from the use of reconstructive processes to reproductive processes.

The conclusion drawn from these studies is that computer-based drill and practice in the form of arcade games does not assist a student in moving from reconstructive to reproductive processes. However, if a student is using reproductive processes, then the use of drill and practice is effective for increasing the student's rate of correct responding.

The findings indicate that computer-based drill and practice has a positive effect on increasing the rate of reconstructive recall of basic math facts but does not, in itself, cause students to use reproductive recall of facts. Thus, drill and practice is ineffective as a tool for memorizing basic addition and subtraction facts and should not be used for that purpose.

Computer technology has allowed us, for the first time, to engage in micro-level learning research in a classroom setting with large numbers of students. We are able to analyze student learning processes through automatic data collection that heretofore could only be done in laboratory settings. The microcomputer offers the field of special education one of the most powerful research tools ever developed.

FUNDING SOURCE	None Specified

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STUDY

Effects of Computer-Assisted Instruction on Disabled Readers' Metacognition and Learning of New Words

SUMMARY

Background. Research indicates that one of the common features distinguishing successful from less successful learners is their level of metacognitive activity, including the ability to monitor and regulate their own processes for learning. The research literature on computers in instruction tends to focus on immediate learning. More research is needed on the effects of computer-assisted instruction on the learning process itself. This study examined the effects of CAI on the metacognition of disabled readers by examining their ability to predict their achievement level on similar vocabulary-development activities delivered with computers and with a traditional practice format.

Procedures. A computer program was developed to teach the spelling, definition, and correct sentence usage of a list of words. A series of paper-and-pencil activities was developed to parallel the computer program as closely as possible. Four observers were trained to collect data for the group receiving the traditional practice method on the number of trials students performed, the types of trials performed (spelling, definition, or sentence usage), and the amount of time spent practicing the words. The computer program automatically collected similar data for that group of subjects.

Subjects for this study were 32 disabled readers enrolled in a summer reading clinic. Subjects in each group practiced five words using their assigned experimental condition for up to 15 minutes for four consecutive days. Following each practice period they were asked to predict how many words they would get right on a test. An oral test was then administered to each student. On the fourth and final day of practice, subjects were asked to predict how many of the words they would remember in a week. The following week the same oral test was administered to all subjects.

RESULTS

T-tests and correlations were used to measure differences between the computer and traditional groups, and to measure the relationships between certain variables. Table 1 summarizes the significant data.

There were no significant achievement differences, either on the immediate achievement tests or on the retention test, nor did the amount of time practiced by the groups differ.

The results of this study suggest that subjects who practiced words on the microcomputer were less able to assess their current state of knowledge than students using traditional techniques. Several alternative explanations are possible. For example, these students may have focused less attention on their own cognitive activities. Alternatively, these students may have perceived the computer as doing the learning for them. In any case, further research on the effects of CAI on metacognitive processes is warranted.

Table 1
Summary of Data for Group Comparisons

T-Tests

Variable	Computer	Traditional	p
Predictive Inaccuracy	2.2914	.9231	<.001
Number of sentence trials	1.73	3.76	<.001
Number of definition trials	4.9	3.0	<.05

Correlations

	Computer			Traditional		
Session	P	A	r	P	A	r
Day 1	3.46	1.46	.0654	2.0	.833	.757
Day 2	4.33	2.0	.3128	2.2	2.1	.890
Day 3	4.27	2.54	.4728	2.75	1.75	.683
Day 4	4.47	2.43	.0245	3.38	3.23	.690

P = Predicted score (from total of 5)
A = Actual score (from total of 5)

FUNDING SOURCE U. S. Department of Education, Office of Special Education and Rehabilitative Services, Special Education Programs.

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STUDY

A Study of Selected Microcomputer-based Artificial Intelligence Systems in Special Education

SUMMARY

The academic and industrial worlds have shown extensive interest in knowledge engineering and the development of expert systems. Expert systems promise to supply software products that will increase the availability of expertise in important areas. In addition, the associated product development activities should also accelerate the development and clarification of the knowledge area itself.

Major reasons for the lack of artificial intelligence (AI) applications in education are the lack of trained personnel and lack of necessary, but expensive and specialized, hardware and software. These problems can be countered if recently developed software can be shown to validly emulate some of the expertise of special educators. These recently developed software products have been designed to reduce dependence on expensive computer programming services.

The research question is, "To what extent can selected expert systems emulate the problem solving of special educators?" The research is restricted to diagnostic activities and instructional prescription in mathematics and language arts.

This project should have implications for the work of:

1. Policy makers responsible for the allocation of research resources in special education. The Secretary of the Department of Education has already called for the application of artificial intelligence to the problems of education. Research on the value of different AI applications is needed.

2. Developers interested in AI product development. Product development efforts will be enhanced if developers have a research base in specific AI applications.

There is a need to create an acceptable R&D model for expert systems in education. Project staff and others are pursuing efforts in this area.

FUNDING SOURCE

U.S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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HOWELL
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STUDY The Effects of Computer Use on the Generalization of Learning with a Learning Disabled Student

SUMMARY *Statement of Problem*. Although there are a number of articles concerning the use of microcomputers with special populations, there is little actual research being done on the effectiveness or impact of the use of microcomputers with special populations (Hofmeister, 1982; Blaschke, 1985). This is especially true as it concerns students who are diagnosed as having learning disabilities (Schiffman, Tobin and Buchanan, 1982). It may be that the use of computers and educational software will facilitate the ability of this type of student to stay on task for longer periods of time and for the learning that takes place to be generalized outside of the computing situation. This study will attempt to investigate the effects of the use of computer and mathematical software on the attending skills and generalization of learning with a learning disabled student in a special education setting.

Hypothesis 1: Students will increase the total amount of time attending to mathematics-related tasks as a result of the use of computer-based mathematics materials, as measured by an increased amount of time in non-computer-based mathematics activities.

Hypothesis 2: Students will generalize the information gained by using computer-based mathematics software as measured by increases on a posttest of mathematics achievement.

Independent Variables: Computer and mathematics software (Plato: Basic Number Facts, 1982)

Dependent Variables: Performance measures on pretest and posttest of basic mathematics facts (KeyMath Diagnostic Arithmetic Test, 1976)

Procedures. The student selected for this study will be randomly selected from among a class for the learning disabled within the Columbus Public Schools. The treatment will consist of four periods in which the student will be observed. The first period will be a baseline observational session, in which the student will be observed within the classroom as they work on traditional mathematics assignments. The second period will be a treatment condition, in which the student will be exposed to the computer-based mathematics materials for 10 minutes per day for 10 days. The third period will be a return-to-baseline condition in which the student is observed within the classroom as the class works on traditional mathematics materials. The fourth will be a return to the treatment period.

The data collection will involve both traditional quantitative academic performance measures in the form of a pre- and posttest, and applied behavioral analysis methods in the form of an observational recording technique.

Data Analysis. Data analysis will involve a t-test for correlated means to analyze the resultant data for the pre- and posttests. Data from the observational recording sessions will be encoded and then displayed in the multiple-baseline format, as graphic representations of the data.

The implications of this research are twofold:

1. The issue of generalization of computer-assisted learning is of great importance to educators because of the increasing use of software in special education classes. If generalization does occur in similar situations, then the computer may be viewed as a valuable assistive device in the special education environment.
2. There is very little single-subject research being done at this time in the area of computer applications. It may be that this is a valuable research technique that will generate behavioral descriptions and data which is not available from group research studies.

FUNDING SOURCE The Ohio State University

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STUDY Special Purpose Software and Adaptive Peripherals: A Case Study

SUMMARY This is a case study of a 7-year-old boy in a first grade class in a special school. The boy is diagnosed as having cerebral palsy. He is wheel chair-bound with limited use of his arms and hands and he is basically nonverbal, although he has some success with speech sounds as a form of communication. This is an investigation of the application of microprocessor technology to this case. The study traces the progress from the parents' identification of the various features of the problem, to the provision of adaptive hardware (including a specialized wheelchair), and to the development of special purpose software and the integration of this hardware and software into the child's educational program. It focuses on the efforts of the parents to secure educational placements with the potential to appropriately serve their son and to secure adaptive hardware. A morse code communication software program was developed especially for their son, and it has been integrated into his school program.

Parents and teachers have provided very favorable reports of the integration of the software and hardware. However, the parents have logged many hours to promote this progress. There have been some difficulties getting full implementation in the classroom.

The implications of this investigation are that microprocessor technology can benefit a multiply handicapped young child, but only with substantial and sustained parental effort. Much more needs to be done to facilitate access to technology, and the development and match of ameliorations involving technology.

Progress in reading sight vocabulary has been measured and results are being analyzed.

FUNDING SOURCE None Specified

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STUDY An Examination of Learning Disabled Students' Composition in Three Modes: Handwriting, Word Processing, and Dictation

SUMMARY Writing is a complex process that involves a large number of skills at different cognitive levels. Writers must attend to handwriting, spelling, punctuation, usage, style, ideas, purpose, organization, audience, and many other factors. For skilled writing to occur many of the lower level skills must be automatic. The higher level skills must be coordinated to permit conscious attention to be shared among them. Word processing has the potential to help LD students in several ways. The ability to print a neat, error free copy can be tremendously motivating and positively affect students' self-evaluations. For those with handwriting problems, typing and the ease of making corrections may reduce the demands of producing text. The ease of revision may reduce concern with conventions enough to enable students to concentrate more on content and organization.

The purpose of this study was to describe the writing process and written products of learning disabled students using three different composition modes: handwriting, word processing, and dictation. The research combined a case study approach with group comparisons among composition methods.

Eleven fifth and sixth grade learning disabled students experienced in using a word processor participated in this study. Background information on students' writing in the natural school setting was gathered in several ways. First, all available writing done by the students in the current year was collected from word processor data disks, journals, and writing folders. Second, special and regular education teachers were interviewed about their writing programs in general and the writing done by each of the students. Third, the students were interviewed about their writing. Fourth, component writing skills were assessed through administration of the *Test of Written Language*, measures of handwriting and typing speed, and a measure of word processing capability. Finally, writing instruction was observed in students' classes.

Each student wrote three stories, one with each composition method. Students had two individual sessions for each story. In the first session, the student was shown a picture and asked to write a story about it. In the second session, the students were asked to make any revisions they thought would improve the story. Sessions were videotaped. Videotapes were analyzed into time spent on prewriting, production, reviewing (re-reading), revision, pausing, and off-task behaviors. Spontaneous comments of the students and answers to probe questions during and after writing were used in interpreting the planning activities of students. Revisions within the first draft and at the second session were also analyzed.

Several quantitative measures were used in analyzing the resulting stories including the following: number of words, number and length of T-units, mechanical errors, grammatical errors, and vocabulary diversity. A holistic rating of overall quality and a primary trait analysis focused on story grammar elements were also used. In addition, students evaluated their own stories.

As the data have just been collected, results are not yet available. However, a final report will be completed by May, 1985.

Word processing has considerable potential as a writing tool for LD students. However, research on its use is needed to clarify the benefits and problems so that its potential can be realized. In addition, the first study contributes to the limited literature on the writing skills of learning disabled students. Previous research has focused only on the written products; whereas, this study examines the writing process and revisions as well.

FUNDING SOURCE U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs.

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HURLEY

STUDY Publisher's Considerations Toward Software Research and Development

SUMMARY Software publishers have become increasingly more sophisticated regarding the development of microcomputer software for special populations over the past several years. However, three major issues remain to be addressed if the development of special education software (and other technologies) is to keep pace with software development for nonhandicapped persons. The issues to be addressed include the following:

1. The Market. Is there a viable market in software for special groups? Can publishers market enough software to recover development, manufacturing, promotion, and advertising cost? How does a publisher effectively tap the special education market? - OR - Where are we? Where are we going? Where does special education fit into the Scheme of Things?

2. From Theory to Practice How can publishers keep abreast of the current research? How can publishers identify and collaborate with researchers on an ongoing basis? How should/can a publisher interpret basic research to develop practical software for daily use in the classroom? - OR - What does all basic research really mean?

3. Collaboration. How can publishers collaborate with: (a) researcher to ensure timely, technically advanced, instructionally sound software? (b) DOE and professional organizations to ensure dissemination of relevant research information, joint funding of projects, etc.? (c) key technology people to serve on software that is educationally sound and appropriate to the needs of handicapped learners? (d) hardware manufacturers to plan low cost headphone jacks, voice activated units to ensure that as many modes of learning as possible are utilized? (e) SEA and LEA personnel to assist in field testing and crash testing to ensure that software products will be utilized effectively in the field? Finally, how can publishers gain seats on advisory committees of DOE and professional organizations' technology committees to ensure marketability of proposed products and dissemination of information to other publishers through the Software Publishers Association? - OR - How far can we go without a little help from our friends?

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KULIK

STUDY Synthesis of Research Findings on the Effectiveness of Computer-Based Education

SUMMARY The purpose of our research has been to answer basic questions about the effectiveness of programs of computer-based education (CBE): How effective has CBE been in improving instructional effectiveness? Has it been especially effective in bringing about certain types of educational outcomes? Have certain types of CBE programs been more effective than others? Have certain types of evaluation designs been especially useful for showing the true effects of CBE?

The method that we used to answer these questions was meta-analysis -- the quantitative analysis of results from a collection of studies for the purpose of drawing overall conclusions about the topic. Meta-analyses locate studies of an issue by objective searches of the literature; they express features and outcomes of each study in quantitative terms; and they statistically analyze the aggregate results.

RESULTS Computer searches of library data bases yielded 199 separate, controlled evaluations of the effects of CBE on learners. The studies covered elementary school, high school, and postsecondary applications of the computer in a variety of subject areas. Statistical analyses of the collected results showed that CBE programs have generally had positive effects, as measured by several different criteria. These effects were not uniformly high, however, for all types of CBE programs at all instructional levels. Nor were effects equally clear for every type of research design. Study outcomes also differed somewhat in published and unpublished studies.

If future CBE programs are as carefully designed as past programs have been, then they will most likely produce positive results. Development of CBE programs for the schools should therefore be encouraged. The design of such programs, however, should take into account evidence on the somewhat different effects of different types of CBE programs. In addition, research is needed on (a) the factors that have produced somewhat different results in published and unpublished evaluations of CBE, and (b) the factors that have produced somewhat different results in studies using different evaluation designs.

FUNDING SOURCE	National Science Foundation, Exxon Education Foundation
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STUDY Microcomputer Software for Individually Managed Instruction -- The H.E.L.P. Authoring System

SUMMARY This project involved the development of a microcomputer-based authoring system for special education. The system developed provides two levels of authoring capability in recognition of the different roles that special education and regular classroom teachers play in achieving individualized instruction for the handicapped child. At the first level, called Micro-Level Authoring, a teacher is able to produce small, modular units of instructional courseware that cover a single concept and use a particular instructional strategy. These modular units of courseware are referred to as micro-units. A micro-unit is intended to involve the student in 10 to 15 minutes of instruction.

At the second level of authoring, called Macro-Level Authoring, a teacher can select and arrange specific micro-units to form a lesson-unit. Lesson-units are used to meet specific curriculum objectives as well as satisfy the requirements of a student's particular learning need. At the Macro-Level, the teacher assigns one or more lesson-units to a student via a student disk. Each student has his/her own student disk. The delivery program of the system "reads" the student disk and presents lesson-units and their component micro-units to the student in the proper sequence.

The production of the microcomputer-based materials with this system does not require knowledge of a computer language. The authoring system uses "editors," containing menus and prompts, to elicit the information necessary to create instructional courseware. Graphic presentations, including colored text, can also be created.

The authoring system has been developed in UCSD Pascal. In addition, the software incorporates the international GKS (Graphic Kernal System) graphics standards. The use of these standards in combination with the p-System operating system from Softech Inc. insures a high degree of software portability between different microcomputers. This means that instructional materials created on one machine can be transferred to another machine, without having to be rewritten or recoded. The authoring system is presently running on the IBM PC and will be available

	on the 128K Apple IIe and the Apple Macintosh in the future.
FUNDING SOURCE	U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs
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STUDY Applications of Technology in the Education of Severely and Profoundly Impaired Students: Research, Training, and Information Dissemination.

SUMMARY The overall goal of this 2-year project is to increase the utilization of technology in classrooms serving severely and profoundly impaired students by (1) identifying those aspects of classroom management that can be improved or made more efficient through the use of personal computers and related software programs; (2) investigating the effects of computer utilization on the quality of instruction provided to the students and their performances relative to their goals and objectives stated on their individual education program; (3) providing training to special education supervisors, instructional advisers, and teachers to extend the techniques developed through this project to other schools and classrooms throughout Philadelphia; and (4) disseminating information about successful project activities to interested professionals on a national basis. The project will be a collaborative effort of the Division of Education of the Johns Hopkins University and the Division of Special Education of the School District of Philadelphia.

The 12 classrooms participating in the project are located in schools that serve both handicapped and nonhandicapped students and were selected to achieve diversity in student ages and handicapping conditions. Four of the rooms are in high schools, four are in junior high or middle schools, and four are in elementary schools. During the first year, six classrooms (two in high schools, two in junior high or middle schools, and two in elementary schools) will be randomly selected to participate in a treatment condition, with the remaining six classrooms serving in a control condition. In the second year, the project will be extended to six additional classrooms providing both within- and between-classroom comparisons of results.

Each classroom will be equipped with an Apple IIe system (computer, monitor, and printer) and related hardware and software items. Five of the classrooms will also receive Texas Instrument 99/4A color computers equipped with expansion boxes, monitors, and Logo II. The hardware and software will be used (1) to facilitate the planning and design of effective instructional programs; (2) for instructional purposes, particularly in the domain of interpersonal communication and interaction; and (3) to facilitate the collection, analysis, and utilization of data that measure the performance of each student relative to his/her educational goals and objectives. The primary measure of the efficacy of employing microcomputers for these purposes will be observational data obtained at regular intervals reflecting the types of tasks and activities engaged in by teachers and students.

The participating classrooms will serve as sites for training special education supervisors, instructional advisers, and teachers in the hardware and software applications developed and/or assessed by the project. A number of audiovisual presentations and a manual describing these applications will be developed during the latter part of the second project year for distribution in the Philadelphia schools and to interested professionals throughout the country.

FUNDING SOURCE	U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs.
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STUDY	Research Project on the Effectiveness of Microcomputers in Special Education
SUMMARY	The two broad areas being investigated in this project are the effectiveness of microcomputers in improving the learning of handicapped students and the contextual factors associated with these benefits. The research is being conducted with mildly handicapped elementary and middle school students. Current and planned studies focus on instructional games, metacognition, word processing, behavioral and affective outcomes, response latency, software evaluation, student groups and learning strategies. (Specific studies are described in the research summaries of C. MacArthur and J. Haynes.) The major implications are that research efforts must continue and expand. Issues encountered in conducting this research include: 1. Defining research questions in their most useful form. 2. Selecting specific studies from so many alternatives. 3. Designing research software and measurement instruments.
FUNDING SOURCE	U.S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs
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MOLL

STUDY Access Knowledge Base (Knowledge Base on Computer Access and Microcomputer-Based Aids for Persons with Physical and Sensory Handicaps)

SUMMARY Development of the Access Knowledge Base has two primary goals: (1) to provide information that could enable an inexperienced user of the system to find potential solutions to problems related to computer access; and (2) to promote communication and collaboration between current or potential computer operators with physical or sensory handicaps, researchers, developers of aids and equipment, rehabilitation professionals, and employers in the knowledge industry.

In addition to descriptions of commercially available microcomputer-based aids and products facilitating computer access, the knowledge base is expected to provide lists of other relevant information resources such as periodicals, directories and guides, clearinghouses, and computerized networks and databases. It will also list computer manuals available in large or nonprint media. Finally, it will supply information about centers that provide evaluation or other services related to computer access; companies or agencies that sponsor training programs for disabled persons who want careers requiring the use of computers; and centers performing research in the rehabilitation area.

For the most part, the system will be menu-based to facilitate single switch input. It will also be designed to encourage users to pose questions and to make comments on specific topics. These will be automatically routed to designated content experts in those areas. Through opening communication channels in this way, the available store of information should be expanded. Further, such forms of communication would hopefully enhance the ability of researchers and developers of aids and computer interfaces to be more responsive to the needs of consumers.

It is probable that the knowledge base will not be available for access to the general public until the fall or winter of 1985. We are not yet certain how the system will be accessed.

FUNDING SOURCE None specified

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STUDY Summary of Research on Executive Workstations for Persons With Physical Handicaps

SUMMARY The objective of this research is to improve the productivity of persons with physical handicaps as they pursue an academic or managerial career. It is believed that the productivity of handicapped persons can be enhanced through applications of technology to routine office procedures which are handled quickly and effortlessly by nonhandicapped persons.

The UNIX operating system environment has been selected as a focus for research into aspects of an operating system that can be modified to meet the special needs of handicapped users. The choice of the UNIX environment will assure the portability of software developed for the project to new systems that support this environment.

It is expected that long-term research will include examination of technological developments in the following areas: digitized voice recording from phone conversations; recorded voice output messages for support of computer-assisted conversation (by speech impaired persons); automated input from printed material, with storage of graphic images for diagrams; online reference material, such as dictionaries or scientific reference tables; flexible, interactive input (from standard keyboard to single switch or limited audio input); online phone directory and dialing (for regular conversations as well as for communication with computer systems); and complete paper transport output system (for documents, graphics, and diagrams).

FUNDING SOURCE None specified

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MOORE
LAHM

STUDY Robotics, Artificial Intelligence, Computer Simulation: Future Uses in Special Education

SUMMARY This presentation reports on a study which had two primary objectives:

1. To enumerate and describe the ways in which robotics, artificial intelligence, and computer simulation are being applied in other fields; and

2. To identify potential uses of these technologies for special education students.

The study was conducted using a new methodology, developed to identify existing applications of technologies in one field and forecast their future applicability to situations in other fields. The five steps of the methodology are discussed in the presentation.

The presentation briefly defines the three technologies, and describes the "state-of-the-art" of each one, as evidenced by their uses in settings other than education. The presentation also: (1) sets forth the conclusions from the study about the three technologies; (2) enumerates the general conclusions, based on ratings by the expert panelists of scenarios of possible future uses of the technologies; and (3) provides specific conclusions related to individual scenarios.

The need for a new methodology for studying the advanced technologies was identified during the study. A new method was developed and is briefly described in the presentation.

FUNDING SOURCE U.S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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STUDY Microcomputers, Writing, and Learning Disabled Children: Field-based Research

SUMMARY

Writing problems are the most prevalent communication disability of learning disabled (LD) children. This study focuses on the role of word processing programs (text-editors) in teaching writing, since several features of text-editors make them promising writing tools for LD children. Four objectives of this 2-year, classroom-based study are to:

1. Determine whether LD children can develop text-editor facility;
2. Identify the writing strengths and problems of LD children and identify the text-editor features that can help them build on those strengths and improve their writing skills;
3. Explore how remedial teachers can integrate text-editors into their teaching of writing, how students respond to those approaches, and how they can improve LD children's writing;
4. Develop training materials that enable remedial teachers to use text-editors to improve LD children's writing skills.

In the first six months we documented the diverse ways five teachers taught writing to fourth grade LD students, using text-editors. Weekly observation, transcription of verbal interaction around the computer, and interviewing techniques were used. It was found that for children to realize the benefits of text-editors they need systematic training in typing and text-editing, and remedial teachers need further guidance in the teaching of writing. Therefore, we devoted the second six months of Year One not only to continuing observation and analysis of classroom activities, but also to providing teachers with feedback and guidance and to developing a framework for teaching writing to LD students that is based on current advances in writing research.

No studies of LD children writing with text-editors are based on the children having received extensive training in typing and text-editing. Continuing research should include this element, in order to discover the maximal possibilities of this computer tool for LD children.

The perspectives on writing and the assumptions about LD writers which many remedial teachers bring to the use of text-editors may not lead to productive writing experiences for LD children. This suggests that special training may be required in order for remedial teachers to maximize the potential benefits of word processing for LD children.

RESULTS

A major finding of Year One is that remedial teachers bring three different perspectives on writing to their use of text-editors, and the approaches differ substantially in the extent to which they actually use the text-editor to foster a sense of writing ownership in the LD child. Year Two will focus on developing and field-testing classroom approaches and activities based on the framework and findings of Year One.

FUNDING SOURCE

U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs.

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MORRIS

STUDY Technological Needs and Applications

SUMMARY Administer programs targeted at materials development or adaptation for use by blind students. Needs were identified and prioritized by meetings of consultants who are knowledgeable and active in using microcomputers in educational applications with blind students. Additional input was received by means of a national technology/microcomputer questionnaire used to determine perceived needs and to determine the "state-of-the-art" for educational applications with blind students.

The American Printing House for the Blind is this country's primary source for special educational materials to meet the unique needs of visually handicapped students. The results of the research and development program will be products blind students can use so they can benefit, like their sighted peers, from use of microcomputers in the classroom. These products will be distributed by the American Printing House for the Blind.

Projects resulting include: preparation of braille editions of a literacy book and instructional manuals, development of a Basic Familiarity Program, modification of the Textalker Speech Generator (Echo II) spelling program and list builder, and contacts with software publishers regarding permission to adapt programs to make them speak. Evaluations are on the order of legibility studies and in-use critiques by teachers using new programs.

FUNDING SOURCE American Printing House for the Blind

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STUDY Telecommunications and an Interactive Process Approach to Literacy in Deaf Young Adults

SUMMARY This research was designed to seek solutions to a central problem in the education of deaf students, their severely limited ability to read and write English. The research developed a conceptual model that combined and brought to bear on this problem two major areas of recent development in technology and theory. The project model utilized electronic communication in a way that is consistent with current theory and practice in literacy development as an interactive process. The model was implemented, field-tested, and evaluated in five schools for the deaf.

The research was supported by a Distinguished Professor Award from the National Institute for Handicapped Research. The General Telephone and Electronics Corporation (GTE) provided the telecommunication equipment needed for the project. Equipment and telecommunication services included installation of Electronic Mailboxes for all of the students in the project; establishment of an Electronic Bulletin Board, The Deaf Students Newswire; establishment of a Computer Teleconferencing System that enabled the researcher, the Advisory Committee specialists, and the cooperating teachers to have ongoing dialogue with each other; and provision of a special computer program and facilities for analyzing the vast amount of written communication generated in the project.

Five schools for the deaf participated. Each school provided a cooperating teacher and six students. Cooperating teachers received ongoing assistance from the project director on theory and methods of providing a functional reading and writing environment to foster maximum growth in literacy.

A group of distinguished deaf and hearing specialists in literacy acquisition and telecommunications served on an Advisory Committee for the project and provided linkages with the Center for Applied Linguistics at Gallaudet College, the Communication Research Center at National Technical Institute for the Deaf, and the Princeton Research Forum.

Evaluation of the project included both summative evaluation of students' growth in reading and writing skills and formative evaluation analysis of the various project components.

FUNDING SOURCE U.S. Department of Education, National Institute for Handicapped Research

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O'DONNELL

STUDY The Effect of Microcomputer Training in LOGO and Word Processing on Achievement of Children with Learning Disabilities

SUMMARY The proposed research will investigate the hypothesis that microcomputer training in LOGO (a nonverbal, spatial program) and/or word processing (a written language program) results in increased academic achievement for children who have learning disabilities.

A pretest-posttest control group design is planned. A total of 50 students between the ages of 6 and 12 years, who are eligible for special education services for learning disabilities, will be randomly assigned to two groups. Students will be given a pretest as part of the in-depth 8-week assessment at the UMKC Learning Clinic. These students' learning -- capacity, achievement in academic skills, and intra-individual differences -- will be assessed. At the end of the assessment period, Group I will begin a 30-week microcomputer training during the child's regular school day in a school district in the Kansas City area. The microcomputer training will consist of daily sessions with graduate research assistants. Group II will receive no treatment; however, a teacher-aide will provide Group II students with an activity for the same period of time and to the same number of children as Group I. In the final two weeks of the proposed project, the posttesting will be made and a double-blind comparison of pretest and posttest data from Groups I and II will follow.

The proposed study is seen as a feasibility study, as a beginning phase for a series of studies on the effect of the computer when used with learning disabled students in assessment and remediation. Four research questions will be considered. The first is experimental and will be analyzed with factorial analysis of variance methods. The second is exploratory and will be evaluated by means of correlational methods. The third and fourth require clinical observation and will be addressed through descriptive analysis.

1. Primary research question. Will microcomputer training in LOGO and/or word processing increase academic achievement for students who have severe or moderate learning disabilities?

2. Primary research question. Is there a relationship between the content area of the disability (e.g., reading, spelling, math, writing, language) and the ability to acquire LOGO and/or word processing?

3. Secondary research question. Can severely and moderately learning disabled students at the elementary school level learn microcomputer programs in LOGO and/or word processing?

4. Secondary research question. What adaptations are required for disabled students to use existing LOGO and word processor programs designed for young children? Is there a need for a special training program for learning disabled students in microcomputer uses?

The results of the study may have implications for software development and/or instructional methods for teaching computer programs to learning disabled students. In addition, it is expected that the interaction between learning difficulties and the computer programs for LOGO and word processing will be better understood.

Comparative instructional features of the numerous word processing programs has been a major issue in designing and conducting this technology-based research.

FUNDING SOURCE Weldon Spring Endowment Fund, University of Missouri-Kansas City

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PANYAN
HAZAN

STUDY An Authoring System for Individualized Instruction and Applied Research

SUMMARY The purpose of this program was to develop and field-test a prototype microcomputer-based multisensory authoring software system for special education, designed to improve the individualized instruction of learning disabled children.

An overview and description of a new authoring system for special education will be presented. Initial field-test results for six LEAs will be shared.

The authoring system as a vehicle for research as well as teaching will be discussed. First, the system affords a comparison of an adaptive learning model (through program branching and teacher generated changes) with a program without these features. Secondly, the use of the authoring system to examine process and content variables on learning rates and patterns will be illustrated.

The proposed model for researching learning variables is "user-friendly" and has direct implications for instruction and success during instruction. Also since data are collected by the computer program, teacher acceptance should be maximized.

One issue encountered during this research investigation was the difficulty of obtaining a consistent independent variable when the nature of the intervention is changing due to necessary adaptations and adjustments.

FUNDING SOURCE U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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PRINZ

STUDY ALPHA Microcomputer-Videodisc Project for Young Children: An Interactive Approach to Reading, Computer Writing and Communicative Development

SUMMARY This research project involves a new method for teaching young children to read and "write." The study incorporates the use of a portable microcomputer and videodisc player in the classroom to allow the child to initiate communication from the very onset of instruction. Traditionally, children using computers and interactive video-assisted learning have been required to respond to statements and questions and their responses have been required to fall within a small range of acceptable answers. Such an approach provides the child with limited opportunities to initiate language or to be an active catalyst in communication. The subjects included in the first study are 75 deaf and 25 multiply handicapped children between the ages of 2 and 15 years, with average or better intelligence. The children are enrolled in schools in the Philadelphia and Pittsburgh metropolitan areas. The children are trained to use a novel interactive microcomputer system with a special interface keyboard which builds in perceptual salience, individualized vocabulary, animation of pictures, and graphic representations of signs from American Sign Language (ASL). The child is taught to press keys with pictures, words, and short statements drawn from the child's own central interests and favorite expressions. This is possible because (1) the keys are readily changeable; (2) new words and graphic representations of pictures can be quickly and efficiently entered in the computer; and (3) permanent disc storage allows instantaneous access to many printed words, accompanying color graphics, and actual pictures from the videodisc.

RESULTS Children read sentences and write sentences and also communicate to the teacher about the messages printed, pictured, and signed on the computer's display screen. The learning mechanism underlying this novel instructional system is best characterized as responsive, interactional, and exploratory, reflective of the way in which most children acquire a first language. Preliminary results of the study have demonstrated a significant improvement in word and phrase identification, reading comprehension, and basic sentence construction or writing. The increase in writing, reading, and communication skills is attributed to exploratory learning -- not solely programmed instruction -- which allows the child to flexibly investigate the representation of various printed forms which relate to the child's own primary mode of communication.

FUNDING SOURCE U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs.

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STUDY An Analysis of the Instructional and Contextual Variables That Influence the Efficacy of Computer-based Instruction for Mildly Handicapped Secondary School Students

SUMMARY This project is a 4-year study investigating and reporting on the use and efficacy of microcomputer-based instruction with mildly handicapped secondary school students. Studies are underway using quantitative and qualitative methodology to examine the instructional, contextual, and interpersonal variables that may influence the effectiveness of microcomputer-based instruction.

To date observational data have been collected in 53 classrooms across three school corporations. Data have been collected to analyze the impact of the microcomputer upon curriculum content, teacher behavior, student behavior, instruction, and the teacher's instructional focus. In addition the data are being analyzed to determine the impact of microcomputer-based instruction on student academic learning time and achievement.

A comparison of special education classes where a computer was in use versus classes where a computer was not in use indicated: (1) very small differences in teacher and student behavior, instruction, and the teacher's instructional focus, indicating in the observed classrooms that the computer had little impact upon the general ecology of the secondary classroom; (2) consistent with the greater prevalence of math software, computers were most likely to be used for mathematics instruction; (3) students enrolled in classes where the teachers used computer-based instruction spent 24.1% of their time working with the computer; (4) paper/pencil activities were higher in computer-use classroom than in noncomputer classes suggesting that the time created by using the computer as instructor was invested in paper/pencil activity which was found by Rieth and Frick (1983) to increase the likelihood of student off-task behavior by seven times; (5) computer class students were more likely to be actively engaged than their counterparts in noncomputer classrooms.

Interview data were collected from 51 teachers who participated in the observational study and from 25 randomly selected mildly handicapped adolescents. Key findings from the teacher interviews indicate that: (1) teachers presently use computers predominantly for mathematics instruction although they desire to use them in a much broader range of subject areas; (2) machines are used predominantly for drill and practice, to reward student performance or behavior, or to present games that have no instructional content; and (3) major obstacles to computer use are the unavailability and inappropriateness of computer software, location outside the classroom, and the potential misuse or overdependence on technology; (4) characteristics of good software included ease of use or comprehensibility of directions, minimal reading required, appearance (sound, graphics, animation), and fun for students.

RESULTS

Students interviewed were generally pleased with computer-based instruction and would like to use the computers more than they do currently because they felt that the computers helped them learn school subjects. Fun was the most important software criteria for students.

Presently, intervention studies are being conducted to determine the effects of the microcomputer on instruction, the classroom ecology, student behavior, and teacher behavior. Issues being explored include: (1) the additive effect of the computer to pedogogically sound instruction; (2) the effects of time on computer and software quality on teacher and student behavior; (3) the effects of different types and timing of feedback on student performance; (4) the effects of increased direct and computer-based instruction upon academic engagement, achievement, grades, and attendance; and (5) the effects of different training strategies and content upon the use of computers as teaching tools.

FUNDING SOURCE

U. S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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STUDY Direct Computer Instruction: Issues of Assessment, Effectiveness, and Generalization

SUMMARY Past research has not clearly demonstrated the relative effectiveness of direct computer-assisted instruction versus teacher-assisted instruction. A series of research projects were designed to address this issue as well as related issues such as appropriate assessment procedures to select children who would benefit from computer-assisted instruction, collateral behavioral management (self-stimulation, acting out, inattention), and generalization of skills acquired with the computer to more typical learning situations. Our subject populations have focused on somewhat diverse groups including those labeled autistic, severely emotionally disturbed, and learning disabled.

Two studies involved direct comparison of teacher instruction with computer instruction. The first study was conducted with children labeled autistic, neurologically impaired, emotionally disturbed and mentally retarded. A second study was conducted with children labeled as learning disabled. Both studies employed a similar methodology in that all subjects participated in both conditions. In one condition an Apple computer was programmed to deliver instruction in mathematics. In the parallel condition (matched for pacing, difficulty level, degree of interchange, reinforcement density, etc.) a teacher delivered a similar instructional program. High quality voice synthesis was utilized with the severely impaired group of children during computer instruction. In the study with the learning disabled children, psychophysiological measurements were taken to assess the construct of attention in a multidimensional fashion, that is, in addition to latency and performance measures.

A third study was conducted to assess the degree of generalization of skills learned on the computer. This group of children was labeled as emotionally disturbed and autistic and had basic pre-academic skills. Mathematics again served as the task and instruction was delivered only via computer. Generalization measures were taken with respect to performance on standard worksheets and flash card tasks in the classroom setting.

The three studies also attempted to assess predictive variables for child performance under computer instruction and teacher instruction. A specific computer programming algorithm was developed that measures a multifaceted array of child performance when using the computer. This includes not only recording correct and incorrect responses, but also presence of no response, latency for each response, the degree of self-stimulatory behavior as indexed by random pressing of keys, number of type and repetition errors and full pattern, and trial-by-trial analysis. In addition, the software utilized allowed the instructor to completely individualize all response-dependent parameters, that is, the type of problems, their degree of difficulty, their sequencing, reinforcement density, reinforcement type, speed of presentation of problems, presence of verbal feedback, visual feedback, negative feedback on incorrect responses and positive feedback on correct responses. In this way, software can be tailored to the particular idiosyncratic style of each learner. This software series now encompasses mathematics training with remedial tutorial exercises keyed to automatically engage based upon a series of incorrect responses, matching-to-sample tasks, acquisition of alphabet skills, and spelling skills.

This line of research was designed to pursue the use of the computer as an assessment/diagnostic tool to strip away social learning history from the specifics of the task that is to be taught. The effect upon collateral behavior has been very strong in that with some children there has been virtually a complete suppression of self-stimulatory and acting out behavior with computer instruction, but not with teacher instruction. However, here again, there are individual differences and this may allow us to analyze in a more sophisticated fashion than has previously been possible the various motivating factors for "psychotic" behavior that in the past have been confounded with significant social interaction variables.

RESULTS

The basic finding of our research has been that computer-assisted instruction can be as effective as teacher instruction, but that it is both hardware dependent (that is, it is very dependent upon the particular sophistication of the computer system) and is somewhat population specific, although individual differences are apparent in all populations. We do have a predictive model based on our results that allows for subject selection as to who has the greater probability of benefiting from such computer-assisted instruction. It appears that some of the initial positive effects with learning disabled children are quite transitory and are tied to novelty effects, whereas with more severely disturbed children, the effects are more directly related to the specifics of the instructional paradigm and the degree to which the computer can carry these out in a flawless fashion. Generalization was easily achieved for the majority of subjects, although this was not universally the case. Specifically, in one case study, there was no generalization until clinical intervention for the child's nonresponding in the classroom setting. Given this child's early history of physical abuse and fear of interaction with adults, this particular paradigm has potential for assessment procedures above and beyond analysis of academic skill acquisition.

FUNDING SOURCE	Children's Unit for Treatment and Evaluation, SUNY-Binghamton
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STUDY

Studies on the Use of Microcomputers to Facilitate Literacy Development

SUMMARY

Research was conducted to construct and test a model of how the microcomputer can be used to foster progress in reading and writing with children who have experienced continued failure in acquiring basic literacy.

The methodology involved observations, analysis of transcripts from videotapes, pre/post-reading and writing tasks, analysis of weekly writing by students, behavioral and perceptual measures. Most of the primary data was collected during children's writing sessions using a microcomputer, a word processing program, and synthesized speech.

The implications of the research are:

1. The microcomputer can provide children with a context for literacy learning through the use of multiple modalities.
2. The microcomputer can provide children with needed forms of assistance which lead to increased compentence in reading and writing.

The findings confirm that the microcomputer can effectively provide forms of support, feedback, and repetition, which enable children to make progress in reading and writing.

FUNDING SOURCE

IBM Corporation, Apple Foundation

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STUDY Microcomputers in Special Education: Beyond Drill and Practice

SUMMARY The overall project focuses on training, research, and dissemination of information about the use of non-drill-and-practice software with learning disabled and emotionally disturbed students in grades K-8. Objectives of the project include the development of training opportunities in cooperation with Lesley College Graduate School, the formation of a Special Interest Group for educators, and the production of a handbook. The project also has two research components -- a national survey of current practice and a series of small classroom-based investigations. These two components are described below.

1. National Survey of Current Practice. A random sample of 50 U.S. school districts, selected from all school districts using computers in any way for instructional purposes, was surveyed. Each district's special education administrator was interviewed by phone. A teacher from each of the districts in which computers were being used for instructional purposes with special education students was also interviewed. The focus population of the study was learning disabled and emotionally disturbed students in grades K-8. One of the major research questions was: What are the barriers to implementation of beyond-drill-and-practice uses of the computer with this population? Data collection has been completed and data is currently being analyzed. A second phase of the survey, now underway, is the identification of promising practices. Identification of such practices is taking place through press releases, announcements in journals and at conferences, and through professional contacts. A central question in this part of the study is: How have the barriers identified in phase one been overcome by those practitioners who are successfully implementing such uses of the computer with their special education students?

2. Classroom-based Investigations. These investigations are conducted as teacher-researcher collaborations. The first year of the project has included observations and case studies of students using beyond-drill-and-practice software (Logo, word processing). Plans for the

second-year include more detailed studies of particular uses of the computer. These studies will be planned with teachers during the spring and summer of 1985. We are particularly interested in the importance of teachers as collaborators in research.

RESULTS Preliminary analysis of the survey results indicate that the most significant implications of this data are likely to be in the areas of teacher training and policy. There appears to be a poor match between the needs of special education teachers and their students and the type of computer education which most of these teachers have received. Poor articulation of goals or narrow interpretation of learning goals also appear to impede promising uses of the computer with special education students.

Implications from the classroom investigations will be practical ones -- what kinds of experiences work well with particular students, what kind of teacher intervention is needed, how can outcomes be evaluated by educators.

FUNDING SOURCE U.S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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STUDY Writing Productivity of Learning Disabled Students: The Effects of Using a Word Processing Program

SUMMARY The purpose of this study was to begin the empirical investigation of the effect of using a word processing program on the writing skills of learning disabled elementary students. The following research question was examined: Do learning disabled students who use a word processing program (Bank Street Writer, 1985 version) to complete writing assignments differ on selected measures of writing productivity from students who complete writing assignments using a pencil and paper?

Eighteen students in two learning disabilities self-contained classrooms served as subjects in this study. All students wrote two stories per week for 8 weeks. Students in the experimental group used a word processing program for writing during the last 4 weeks of the study. Productivity measures included number of: words, different action verbs, different describing words, different sentence beginnings, spelling errors, capitalization and punctuation errors, and a measure of vocabulary diversity. The data are being coded and analyzed at this time.

This study was an initial investigation in what will likely be a series of studies designed to determine the most effective and appropriate instructional interventions to accompany the use of the microcomputer as a writing tool.

One outcome of this study was a set of files (activities) for teachers to use in training elementary-age learning disabled students to use the Bank Street Writer program. Future studies will focus on the development of strategies of instruction as well as more specific investigation of the writing process (e.g., revision strategies used by students who have difficulty writing).

FUNDING SOURCE University of Virginia, Dissertation Research Award, Department of Special Education

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SEELEY

STUDY

Research and Development of Microcomputer Courseware Authoring System for Learning Disabled Students

SUMMARY:

Research Questions:

1. What are appropriate roles for regular and special educators in implementing new technologies at middle school level?

2. What is the appropriate role training for teachers to implement new technologies?

3. How can a microcomputer authoring system be best implemented with special and regular education teachers at middle school level?

Methodology:

1. Observation
2. Interviews
3. Role Training
4. Training in Instructional Design
5. Implementation of Authoring System
6. Evaluation
7. Dissemination

FUNDING SOURCE

U.S.Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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STUDY Project TEECh (Technology Effectiveness with Exceptional Children)

SUMMARY Project TEECh is a federally funded, 4-year program of research on the effects and effectiveness of microcomputer instruction with mildly handicapped children in elementary schools.

The investigators have developed a model to assess the contextual variables which affect microcomputer allocations, access, and use patterns for mildly handicapped students. The impact of these contextual variables is traced through a path model, from those factors most distal to microcomputer use in the classroom (e.g., federal and state educational policies) to those more proximal to actual use (e.g., teacher training and special education resources). Through this path model, the range of possible Micro-Educational Environments which the students may experience is delineated. Micro-Educational Environments are defined in terms of the microcomputer configuration (e.g., hardware and software), special educational administrative arrangement (e.g., resource room, special day class, mainstream), students' characteristics, and teacher attitude and training. Micro-Educational Environments may also be defined by the administrative contextual variables which affect these environments. This description of Micro-Educational Environments is followed by an analysis of microcomputer effects within these environments, with analyses of student-microcomputer interactions setting the stage for studies on microcomputer effectiveness within these contexts.

RESULTS Our major research findings address how mildly handicapped students gain access to computers and how they spend their time while they are on the computer. Our findings focus both on the nature of the Micro-Educational Environment (MEE) and student use patterns within these environments. Overall, it is apparent that while the newness of the technology has resulted in little consensus with regard to software with a focus on math drill and practice programs, students are highly engaged by the media. Nevertheless, the appropriateness of this instruction, and its effectiveness for cognitive and affective growth in mildly handicapped students, remains in question.

General findings for Year One include:

1. For LH students the main access to micros is in RS and SDC programs; access for mainstream students is split between the lab and classroom.

2. More "off-brand" micros in RS and SDC classes.

3. More individual use in RS/SDC programs; more group use in mainstream.

4. High percentage of time "on-task" across all settings.

5. Little contact with teachers during use; contact appears to increase with the "restrictiveness" of the setting.

6. When peers are present, LH students are more frequently off-task with peers in RS/SDC settings.

7. Individual, small group, and whole class use reported.

8. Teachers' intentions for use varied by setting: RS-individual remediation; SDC - drill; Mainstream-recreation, reward.

9. Math software most frequently used in all settings (Reading almost as frequent in RS programs, followed by spelling).

10. Drill and practice type software most frequent across all settings (>90%); "Learning to use computer" type software use declines as restrictiveness increases.

11. No commercial package used with high frequency (110 teachers reported 307 titles; 67% of titles were unique).

12. Administrators mainly believed that motivation, not improved achievement or rate of learning, would be the prime benefit of micros for LH students - across all settings.

13. Only 50% of special education programs owned micros; 51% of those owned were purchased using general fund (32% from federal sources).

14. Purchase decisions typically involved a district committee; allocation decisions typically involved a special education administrator, principal and teacher.

15. Mainstream teachers more frequently had computers located in classroom all day; RS teachers split between class and mobile carts; SDC split between class, labs, and carts.

16. Teachers perceived as having "intro" level computer skills by administrators; 2/3 districts reported recent training; most training provided by regular district staff.

FUNDING SOURCE	U.S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs
RESEARCHER	Melvyn I. Semmel Professor and Program Leader Special Education Graduate School of Education University of California Santa Barbara, California 93106 805-961-3477

STUDY Special Education Work-Station Design and Evaluation

SUMMARY The Special Education Work-Station project of Georgia Tech's Physio-Automation Laboratory is being conducted in cooperation with the Georgia Computer Programmer Project that is sponsored by Goodwill Industries. The research objective is to improve the functional and cost effectiveness of universal teaching/training work stations for severely physically disabled persons. Methodology involves the application of state-of-the-art computer and robotics technology, together with advanced human-factors engineering concepts, to achieve a highly facilitated integrated work-station system. Examples of sub-system features currently being investigated are:

1. Menu-driven touch-screen, voice-controlled or pneumatically-switched selection of computer operations and microprocessor-controlled adjustment of the work-station's mechanical features;

2. Miniature robotic device (also menu-driven by a variety of user input signals) to supplement or substitute for manual dexterity by presenting reading material, drinking fluids, snacks, or facilitative devices to the trainee; turning pages of a book or magazine, etc.;

3. A robotic multi-surface rotating table, positioned conveniently at one end of the work-station's main table surface and command- or signal-controlled by the trainee to select reading material, notepads, etc.

Through emphasis on economical and flexible designs, and the extensive use of off-the-shelf commercial electronic sub-systems (such as voice control modules for personal computers), the work-station system is likely to experience widespread use.

FUNDING SOURCE Georgia Tech and the State of Georgia, Department of Human Resources (Vocational Rehabilitation)

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STUDY Development of a Camera for Use in Sensory Aids for the Blind

SUMMARY The task is to determine how contemporary solid-state technology can be utilized in an integrated design to produce a reading aid for the visually impaired which is useful, portable, durable, and affordable. The final device is to comprise (a) an imaging unit in a hard-tracked camera with bundled optics and illumination; (b) a microprocessor to image processing and optical character recognition on the captured data; and (c) an interface board to allow the results to be sent to commercially manufactured devices for display. Current research focuses on questions of technical implementation, with custom equipment being built to demonstrate feasibility of alternative approaches, their advantages and disadvantages.

A final device of this sort should find application not only in sensory aids for the visually impaired but also in reading remediation programs for learning disabled persons as a training tool, and in rehabilitation programs for dyslexic adults. Results suggest VLSI design is well suited to meeting anticipated demands.

FUNDING SOURCE VA Merit Review Approved Proposal

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STUDY

Development of a Computer-Aided Visual Communication System for Aphasic Individuals

SUMMARY

The task is to develop a useful computer-based visual communication system to provide severely aphasic individuals with a means for effecting simple functional communication. The approach is to utilize the most recent technical advances in microprocessor design, computer graphics, interface devices, and aphasic research to design a system which draws on the interact residual abilities of aphasic persons. Research questions being addressed include: (a) how should such a system be configured; (b) what subpopulation of aphasics can benefit most from this approach; (c) how can they be most quickly identified; (d) what is the most effective training regimen? A preliminary laboratory system has been assembled and the first subjects are now in training, with usefulness in several regards demonstrated.

A system of this sort could be useful in aphasia therapy as well as in long-term aphasia remediation. It should help aphasiologists and neurologists to specify more precisely the nature and extent of communicative function that can coexist with severe aphasia. It could also be useful in training regimens for some severely learning disabled or otherwise disturbed children.

FUNDING SOURCE

VA Rehabilitation R&D Center Core Funding

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STUDY An Experimental Test of a Microcomputer/Videodisc Program to Develop the Social Skills of Mildly Handicapped Elementary Students

SUMMARY This study determined the effectiveness of a videodisc-based social skills training program for mildly handicapped elementary children.

The program teaches children how to use appropriate phrasing, intonation, and body language in such social interactions as getting involved and being positive. The videodisc is used to present (1) examples of appropriate and inappropriate social behaviors, and (2) models to imitate in subsequent role-playing activities. A daily lesson guide for the teacher accompanies each videodisc presentation. The program also includes a behavior management system that is used during and after the videodisc and role-playing phase.

Six elementary-school resource rooms, each containing five mildly handicapped students, were randomly assigned to participate in the program (experimental group) or to continue their regular resource room program (control group). The students were classified as neglected, accepted, or rejected. Data on the student's social behavior, acceptance by nonhandicapped peers, self-esteem, and treatment implementation were collected over a 4-month period.

RESULTS Experimental group students scored significantly higher on a post-training measure of peer acceptance than did control group students. Also, within the experimental group the neglected and accepted students scored higher than did rejected students. The experimental and control group students did not differ on the post-measure of self-esteem.

An effective use of microcomputer/videodisc technology was demonstrated and a social skills training program was validated.

FUNDING SOURCE U.S. Office of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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STUDY Design and Fabrication of VOCAs at the School District Level

SUMMARY The question guiding this inquiry was: Can the design and fabrication of low cost "entry level" VOCAs (and other computer aids) for low incidence special education populations be supported at the school district level?

Over the past 7 years, Wayne County Intermediate School District (Wayne/Detroit, Michigan) has supported a program of design and fabrication of low cost VOCAs and other computer aids.

The consultant for Special Services, initially funded under a Title I project, is now a full time position in the district's Data Processing Department.

Funds for the VOCAs are recycled through the resale account, i.e. the devices pay for themselves via the resale charge purchasers bear, which consists of component cost and a labor cost of approximately $5-8/hour. All other costs are borne by the intermediate organization.

WCISD currently offers four products:

1. WOLF: nicad-powered microcomputer (65C02) and voice synthesizer (SC01) in Texas Instruments Touch and Tell case: touchpanel VOCA with 30 levels, 475 words user-specified custom vocabulary programmed into (E)PROM. (Vocabulary development system on Apple computer, uses Votrax Type and Talk synthesizer): $275.

2. ZWOLF: nicad-powered microcomputer grafted onto original electronics in Tiger Electronics "K28 Talking Learning Computer": used as VOCA peripheral for bank switches, Zygo scanners: $275.

3. Adaptive Input Card: similar to Schwejda Adaptive Firmware Card, but minus several input modes (e.g., single switch self-scan). Set-up software allows user to author ASCII and spoken vocabularies organized into menus for PowerPad touchpanel Zygo scanners, Votrax type and talk: $150 (card and software)

4. ACES: PowerPad Touchpanel and Votrax Type and

Talk linked by menus, user programmable. Authoring and editing software; simple tutorial mode: $150 (Software)

The electronics for these devices are designed in-house, prototyped and tested and made into printed circuit boards. In the past, enclosures and input panels were also custom made; currently case and touchpanel components are obtained commercially. Fabrication is currently in-house but contracted manufacture is being explored.

RESULTS

There are currently 75 WOLFs and ZWOLFs in the field. The reaction to WOLF is quite favorable and enthusiastic. It is clear that this product meets the needs of low incidence special education populations previously unexposed to VOCAs and other aids because of high cost. As the price of VOCAs drops, educators are more willing to "take a chance" with these devices. What is still needed are curricula that make more use of the VOCAs.

FUNDING SOURCE

Wayne County Intermediate School District

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STUDY	Preschool Assessment Techniques
SUMMARY	My intention is to use microcomputers to present challenges to preschoolers which would require a variety of gross motor responses (each an expected response to a particular visual or aural stimulus). The response time would be measured and recorded so that learning curves could be printed for each session, each group of sessions on the same task, and comparisons between subjects over similar time periods. One initial objective is to distinguish between developmentally delayed and organically defective subjects in a systematic manner without the use of inventories (which are costly and slow to administer and subject to misinterpretation). At the same time the experimental equipment -- dials, knobs, handles, levers, wheels, and keyboards -- could be training gross motor skills. Diagnosis and therapeutic efficacy could be automatically monitored and shown visually over extended time periods.
FUNDING SOURCE	Personal Resources
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ZUCKERMAN

STUDY

Microcomputer Software for Individually Managed Instruction

SUMMARY

The purpose of this project was to develop an authoring system that would allow teachers with little or no programming experience to design courseware for computer-assisted instruction of handicapped students.

The research questions focus on the development of the product. The alpha testing of the SPE.ED Authoring System was a formative evaluation procedure and was viewed as an integral part of the software development process. The overall design of the software was conceptualized, an IPO analysis and a "three-level analysis" that served as the software design reference were developed. As routines were coded, alpha testing was used to detect logic and coding errors. As routines were integrated, alpha tests revealed any discrepancies in the conceptual design and the actual performance of routines. The alpha testing indicated that the access routines and other elements of the software were consistent with the design concept.

Questions of product impact on handicapped students and their teachers will be undertaken after the product is disseminated in final form. In the Beta Test, information about the performance of the SPE.ED Authoring System will be obtained. The Beta Test will be conducted in two waves. In the first wave, subjects will be "special interest, special skilled users" who can provide commentary and feedback on the technical aspects of the authoring system. Subjects in the second wave will represent the target audience for the authoring system. Characteristics of these users include rudimentary knowledge of computers, and minimal programming skills. One of the key factors and issues in conducting beta tests is to maintain a distance from the individuals who are using the software and hardware products developed. Another issue that arises is when should investigators contact beta test participants in order to elicit the response?

FUNDING SOURCE

U.S. Department of Education, Office of Special Education and Rehabilitative Services/Special Education Programs

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